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LANDSAT-D

Mission Operations Review (MOR)

APRIL 6-7, 1982

GODDARD SPACE FLIGHT CENTER

Day 1

I. INTRODUCTION

A. Scope
B. Purpose
C. Mission Operations Participants
D. Agenda Overview

A. Scope: Review The LANDSAT-D System (Flight and Ground Segments) and Support/Cooperating Organizations with Respect to:

- Flight Segment Control and Operation
- Multispectral Scanner (MSS) Scheduling, Acquisition and Processing
- Thematic Mapper (TM) Scheduling and Acquisition
- TM Operations During the Scrounge Period

B. PURPOSE: To Present for Review by the Goddard Review Team the Integrated LANDSAT-D System Operations Plan with Respect to Functional Elements, Personnel and Procedures

C. Mission Operations Participants

PARTICIPANT	RESPONSIBILITIES
LANDSAT-D Project	Overall Project Management
General Electric Co.	Ground Segment Maintenance and Operations
Network Directorate • NASCOM • Ground Space Tracking Data Network (GSTDN) • Tracking and Data Relay Satellite System (TDRSS)/Network Control Center (NCC)	External Communications, Data Transmission (Image, Command, Telemetry) and Foreign Ground Station Logistics Support
Orbit Support Computing Facility (OSCF)	Orbital Pass Prediction Support
Mission Support Computing and Analysis Division (MSCAD)	Orbit Adjust Definition and Analysis/ Global Positioning System (GPS) Support
Applied Engineering Division	Delta Launch Support
Information Processing Division	Photo/Film Processing, Tape Staging/Storage and Domsat Interface Facility (DIF) Support

C. Mission Operations Participants (Cont'd)

PARTICIPANT	RESPONSIBILITIES
Applications Directorate	Science Office: Multispectral Scanner (MSS) System Performance Evaluation/Thematic Mapper (TM) Processing Evaluation
NOAA National Weather Service (NWS)	Cloud Cover Predictions
EROS Data Center (EDC)	User Order Interface; MSS Archive; MSS High Density Tape (HDT), Computer Compatible Tape (CCT) and 241mm Film Production and Distribution; TM Scrounge Product Archive and Distribution
Naval Observatory	Pole Wander Data
Naval Surface Weapons Center	Navigation Data Satellite (NDS) Almanacs

D. Agenda Overview
DAY 1

I. Introduction
- A. Scope
- B. Purpose
- C. Mission Operations Participants
- D. Agenda Overview

II. Landsat-D Program
- A. Landsat-D System Overview
- B. Landsat-D Key Events
- C. Flight Segment Summary
- D. Ground Segment Summary

III. Mission Requirements and Management
- A. Mission Requirements
- B. Operational Mission Management

IV. Flight Operations
- A. Data Acquisition Plan
- B. Control & Simulation Facility Overview
- C. External Interfaces
- D. Flight Segment Operations
- E. Control Center Operations

D. Agenda Overview

DAY 2

V. Data Processing Operations

A. Data Processing Plan
B. Data Processing System Overview
C. Production Control
D. Standard MSS Processing
E. Operational Quality Assurance
F. Typical Day Schedule
G. External Interfaces

VI. Operations Support

A. Operations Support Overview
B. Landsat-D Maintenance
C. Logistics
D. Configuration Management
E. Documentation

D. Agenda Overview

DAY 2 (Continued)

VII. Operational Activation Period

A. Key Events
B. Integration and Test
C. Preparation for Launch
D. System Activation
E. Post-Launch Calibration and Validation

VIII. Overview of Thematic Mapper (TM) Operations During the Scrounge Period

A. Introduction
B. Science Office
C. Accelerated Payload Correction System (APCS) Tape Generation
D. Applications Developmental Data System (ADDS)
E. Landsat Assessment System (LAS)

IX. Landsat-D Performance Evaluation

A. Objectives
B. Scope
C. Organization
D. Approach
E. Requirements
F. Schedule

X. Wrap-Up

II. Landsat-D Program

A. Landsat-D System Overview
B. Landsat-D Key Events
C. Flight Segment Summary
D. Ground Segment Summary

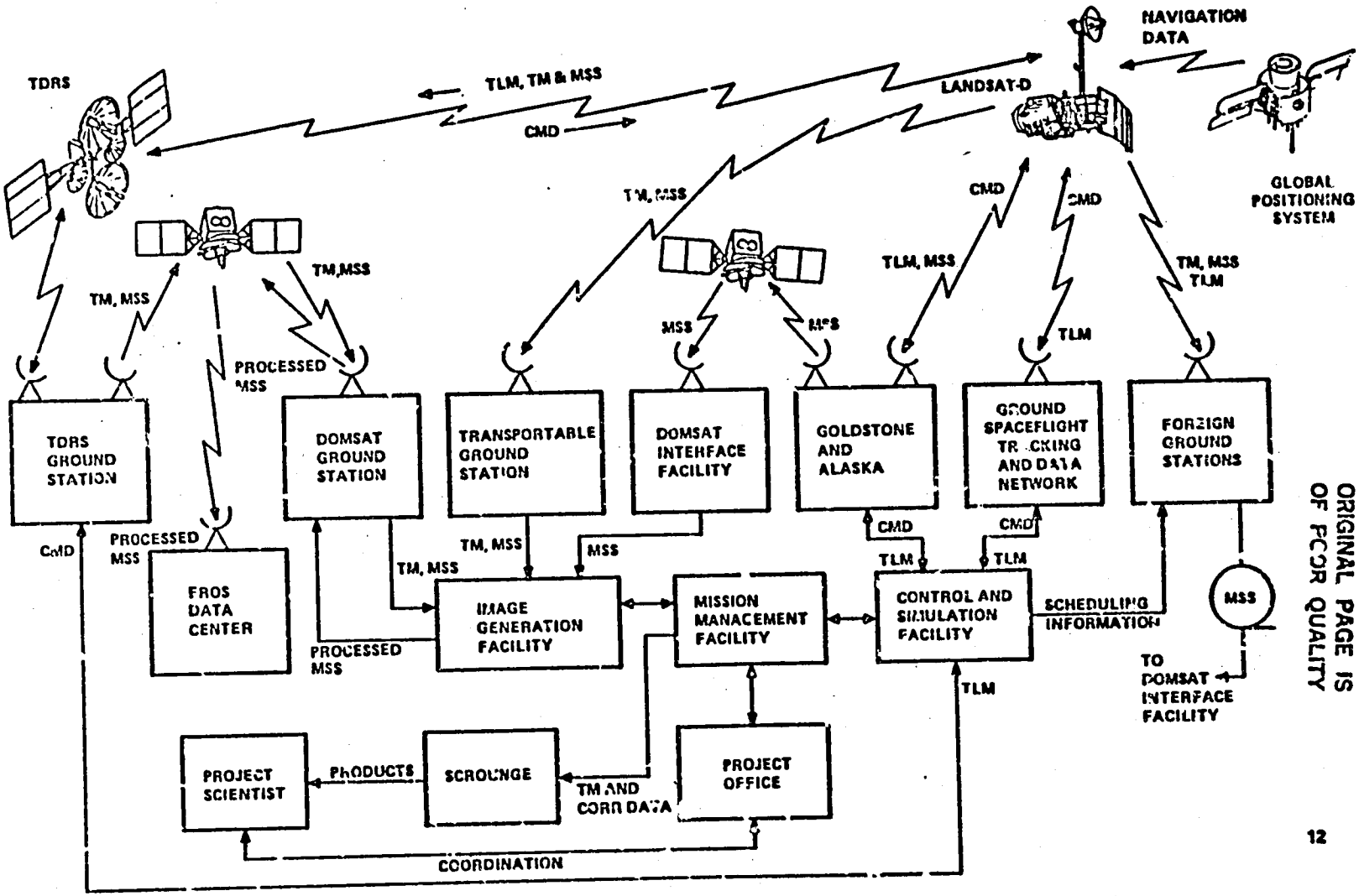
II Landsat-D Program

- PROJECT OBJECTIVES
- LANDSAT-D SYSTEM
- KEY EVENTS
- FLIGHT SEGMENT SUMMARY
- GROUND SEGMENT SUMMARY

Project Objectives

- PROVIDE FOR SYSTEM LEVEL FEASIBILITY DEMONSTRATIONS WITH NOAA AND OTHER USER AGENCIES TO DEFINE CHARACTERISTICS OF AN OPERATIONAL SYSTEM
- ASSESS CAPABILITY OF THEMATIC MAPPER/ASSOCIATED SYSTEMS TO PROVIDE IMPROVED EARTH RESOURCES MANAGEMENT INFORMATION
- PROVIDE FOR CONTINUED AVAILABILITY OF MULTISPECTRAL SCANNER DATA
- PROVIDE TRANSITION FROM MULTISPECTRAL SCANNER TO THEMATIC MAPPER DATA
- PERMIT CONTINUED FOREIGN DATA RECEPTION

Landsat D System Overview



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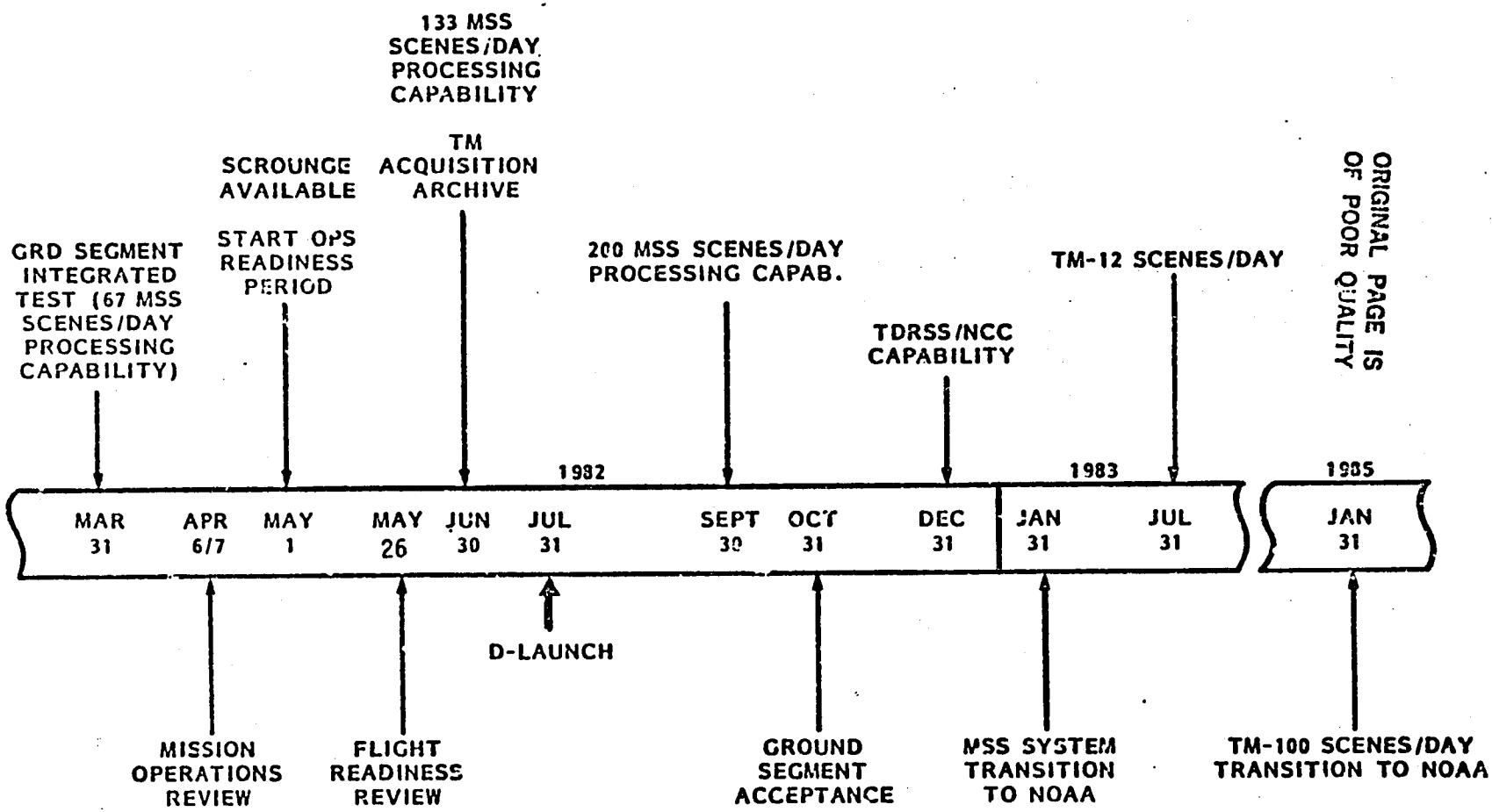
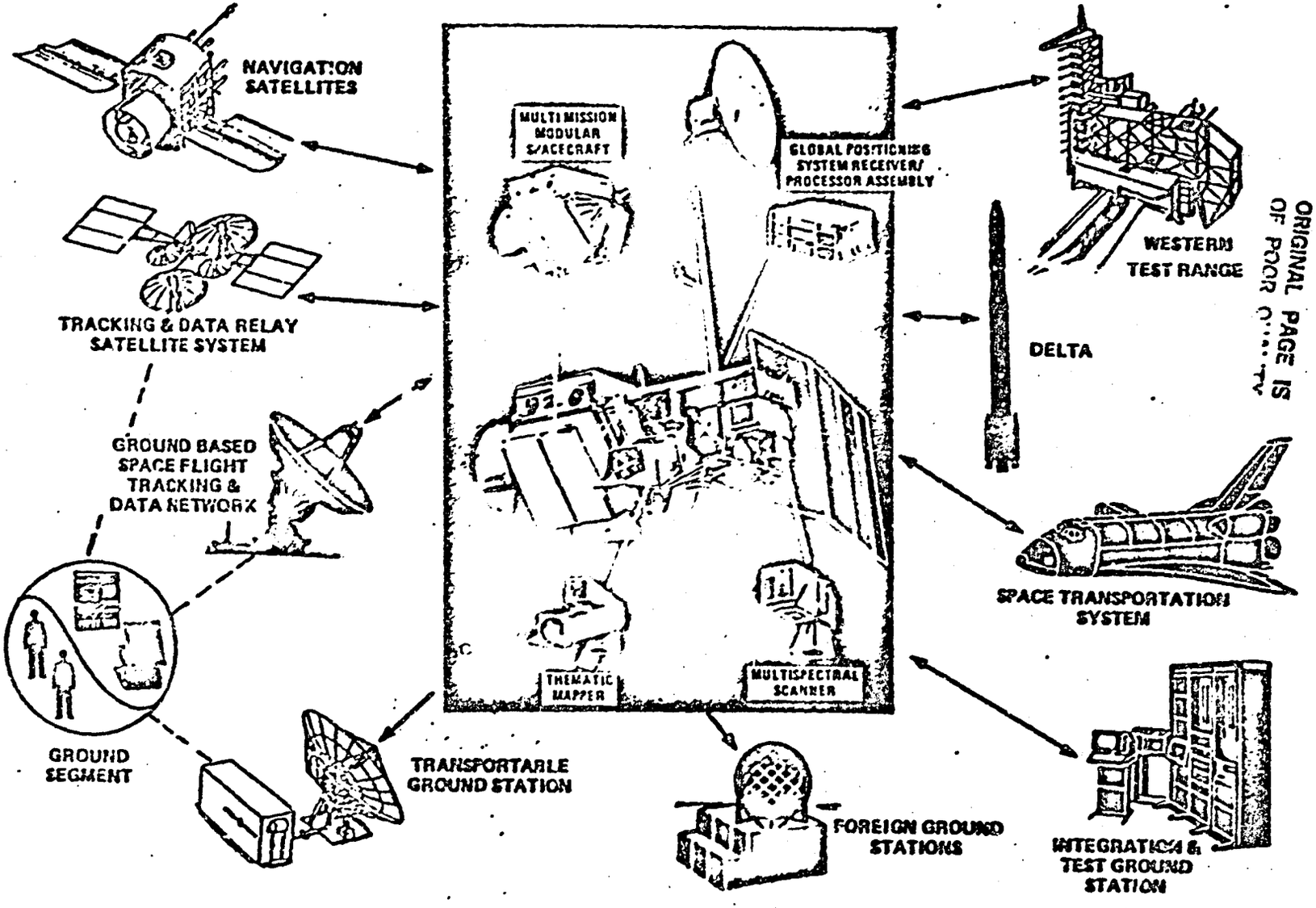
Landsat D Key Events

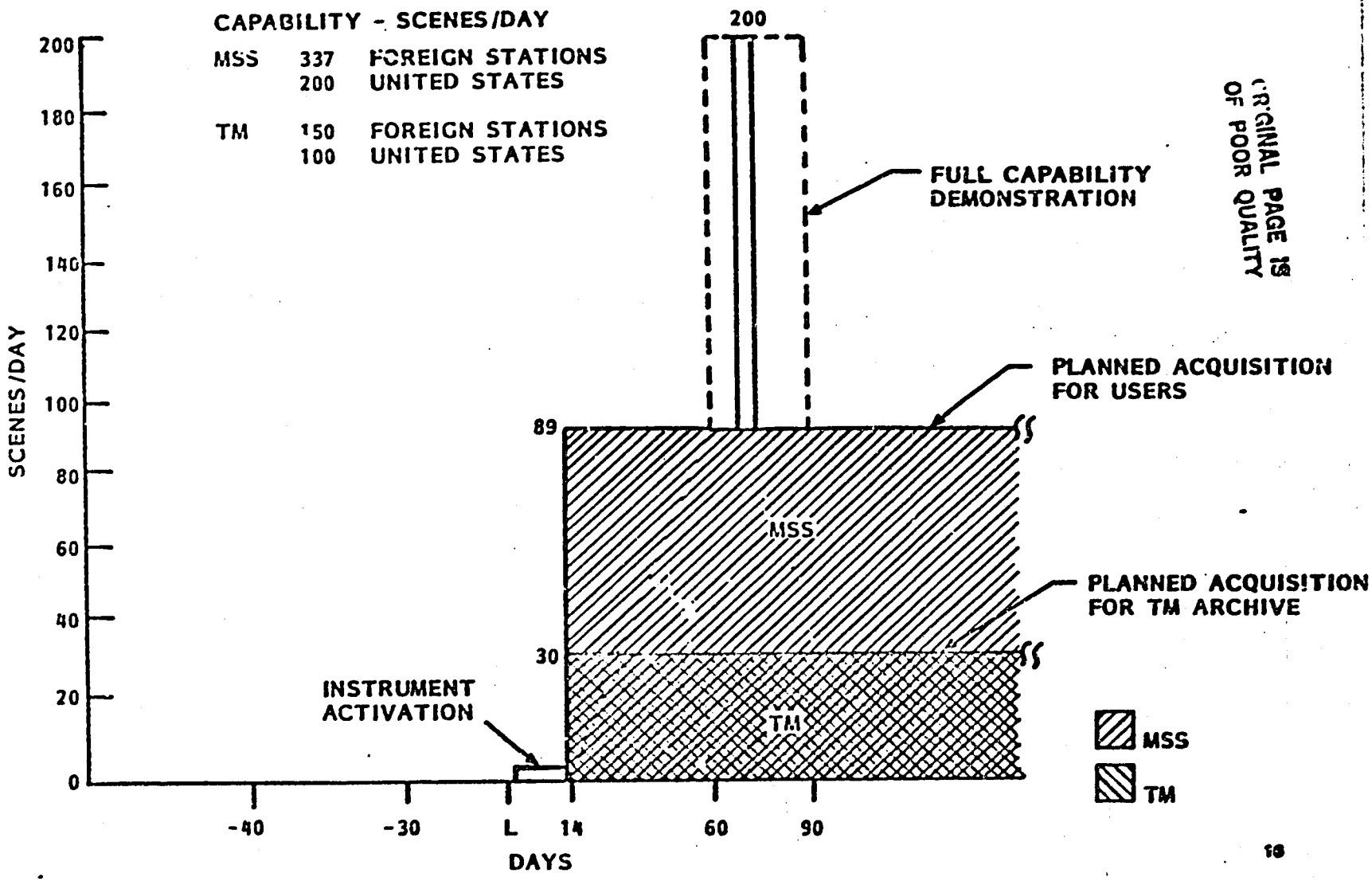


Flight Segment Summary

FLIGHT SEGMENT INTERFACES

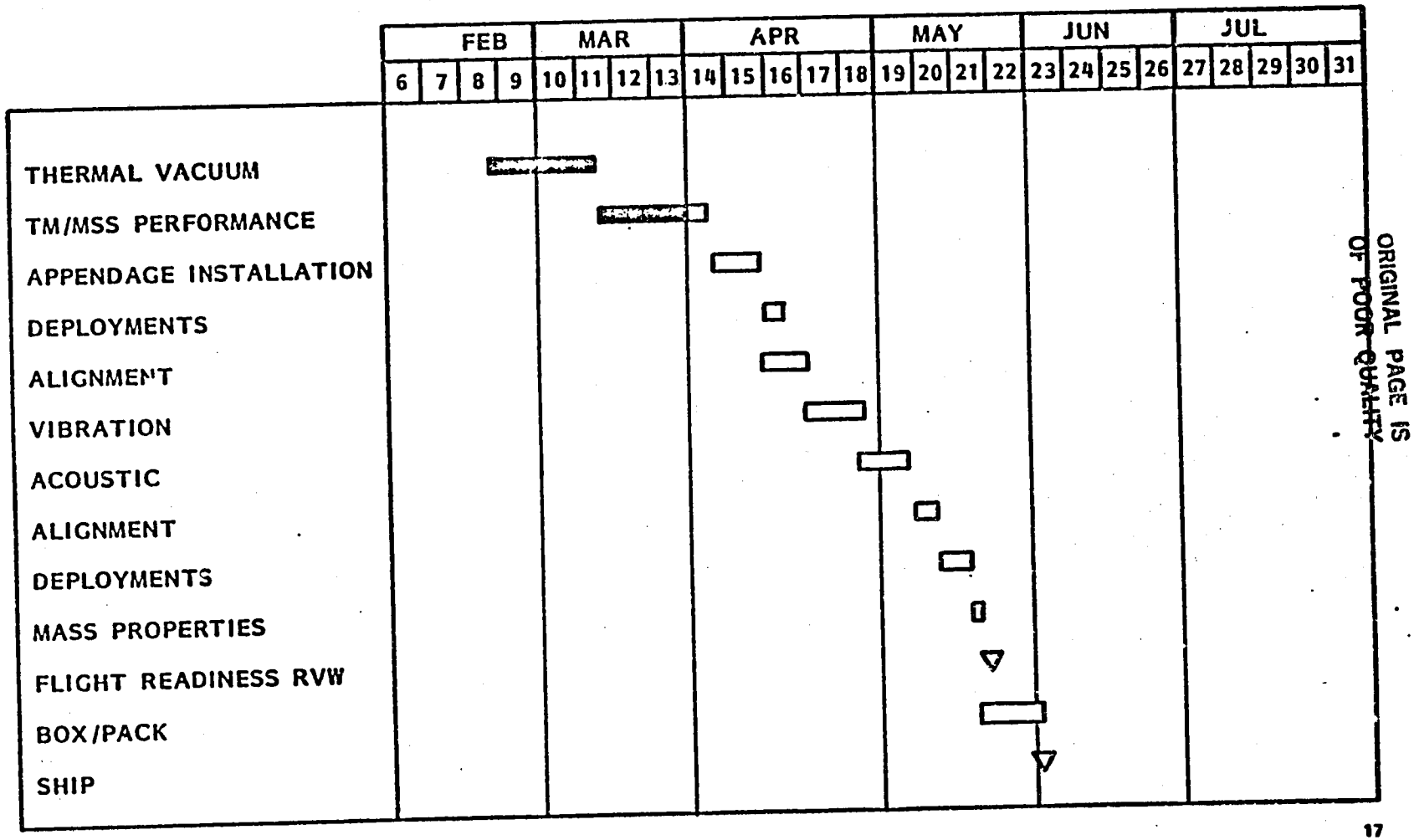


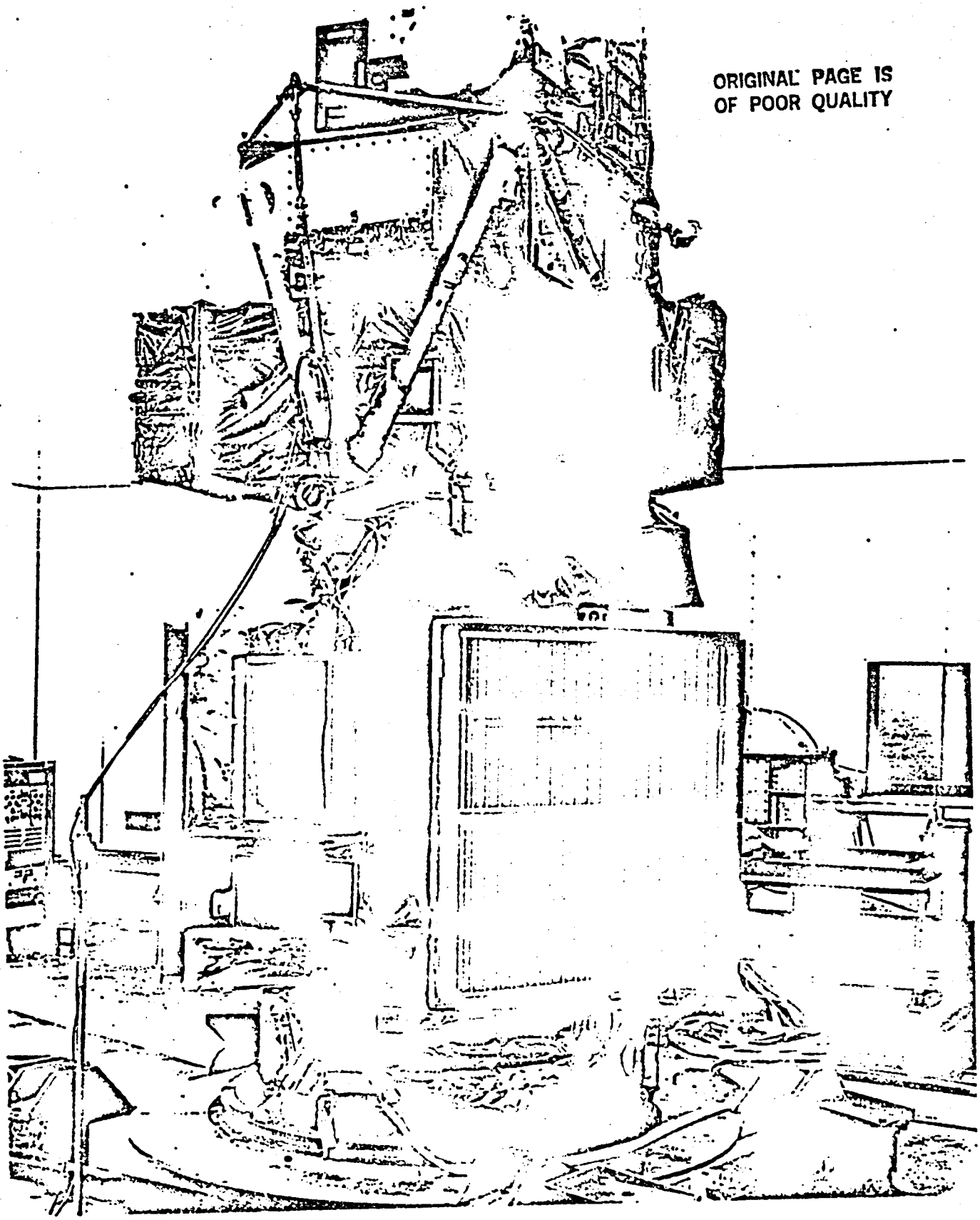
Acquisition

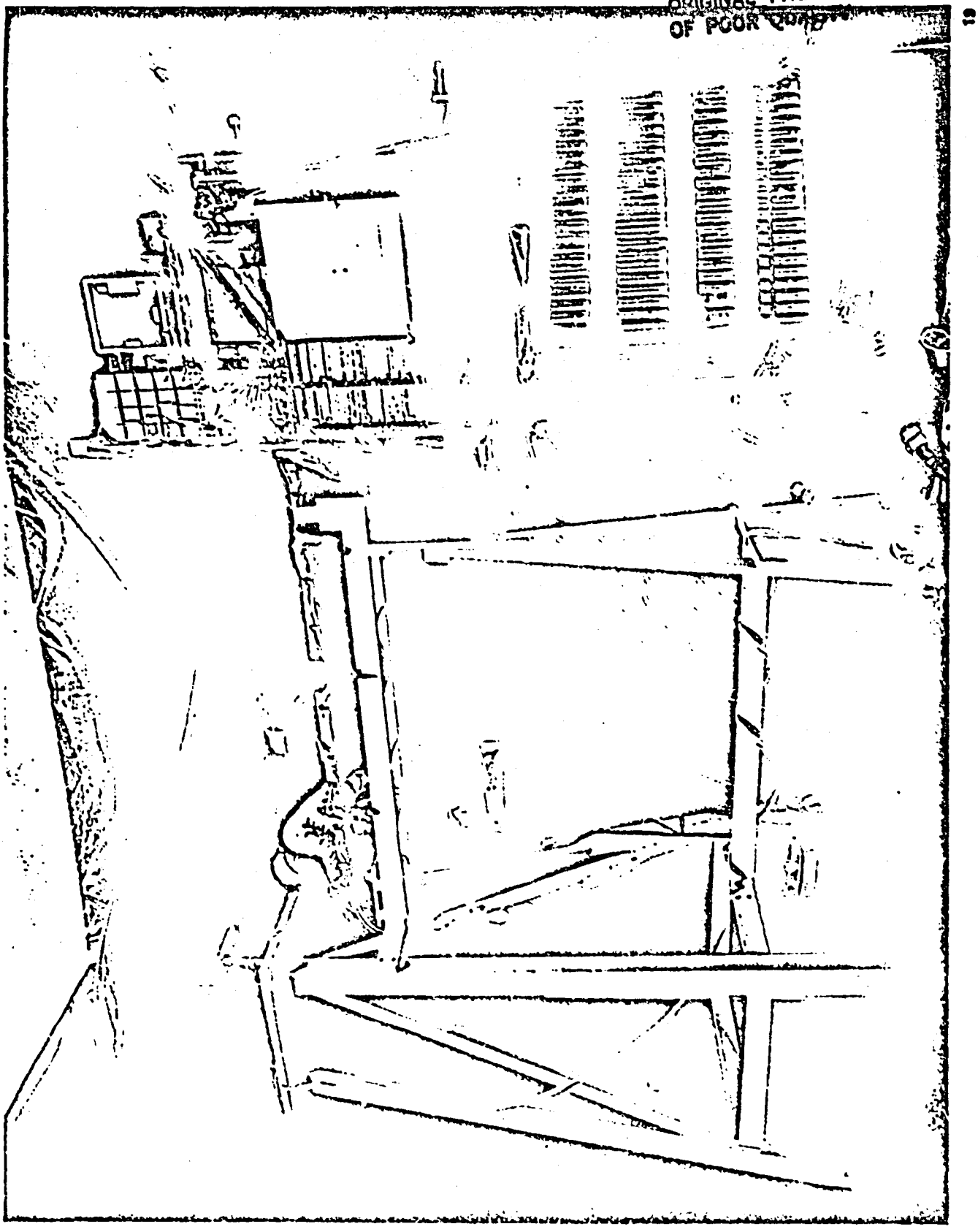


Flight Segment Status

COMPLETED THERMAL VACUUM TEST MARCH 11, 1982







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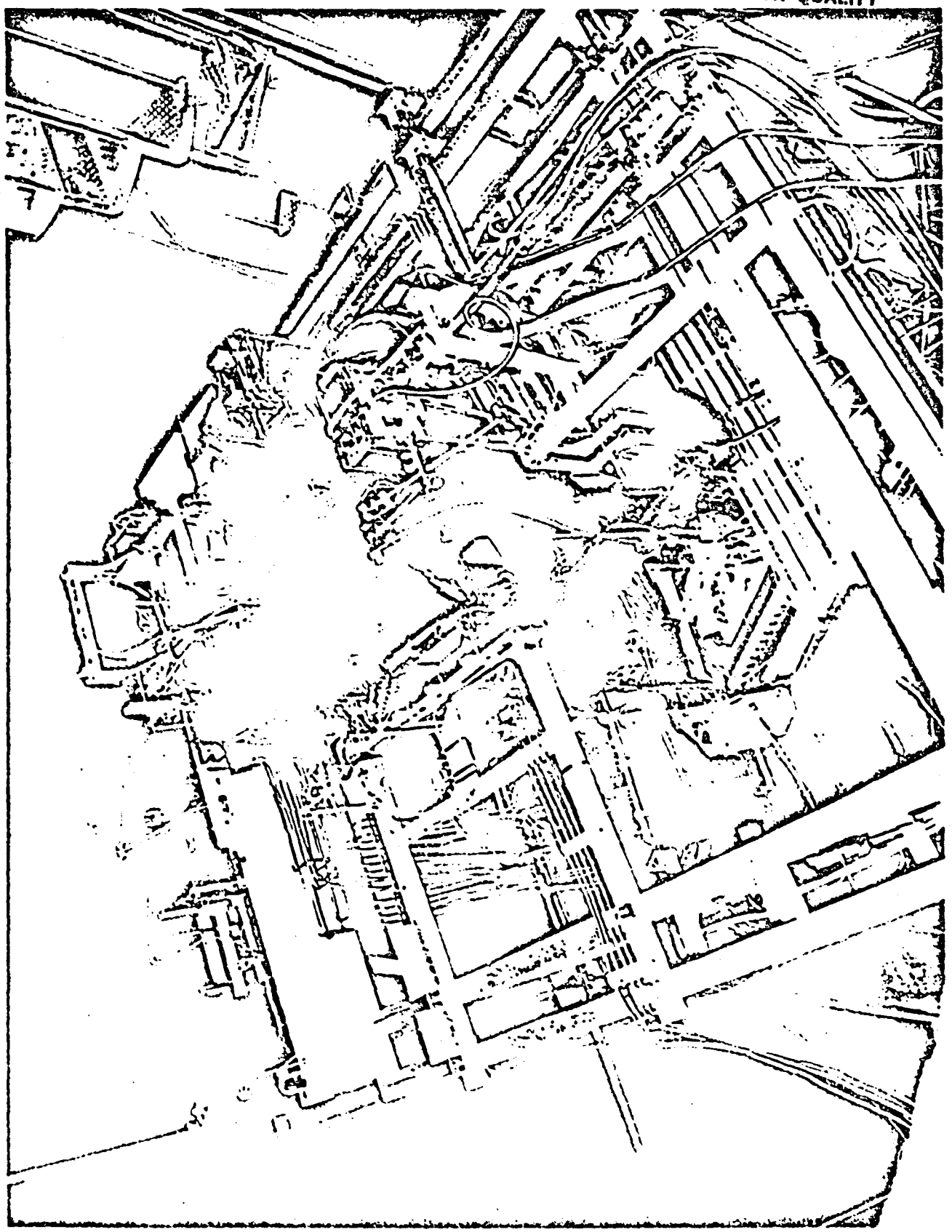
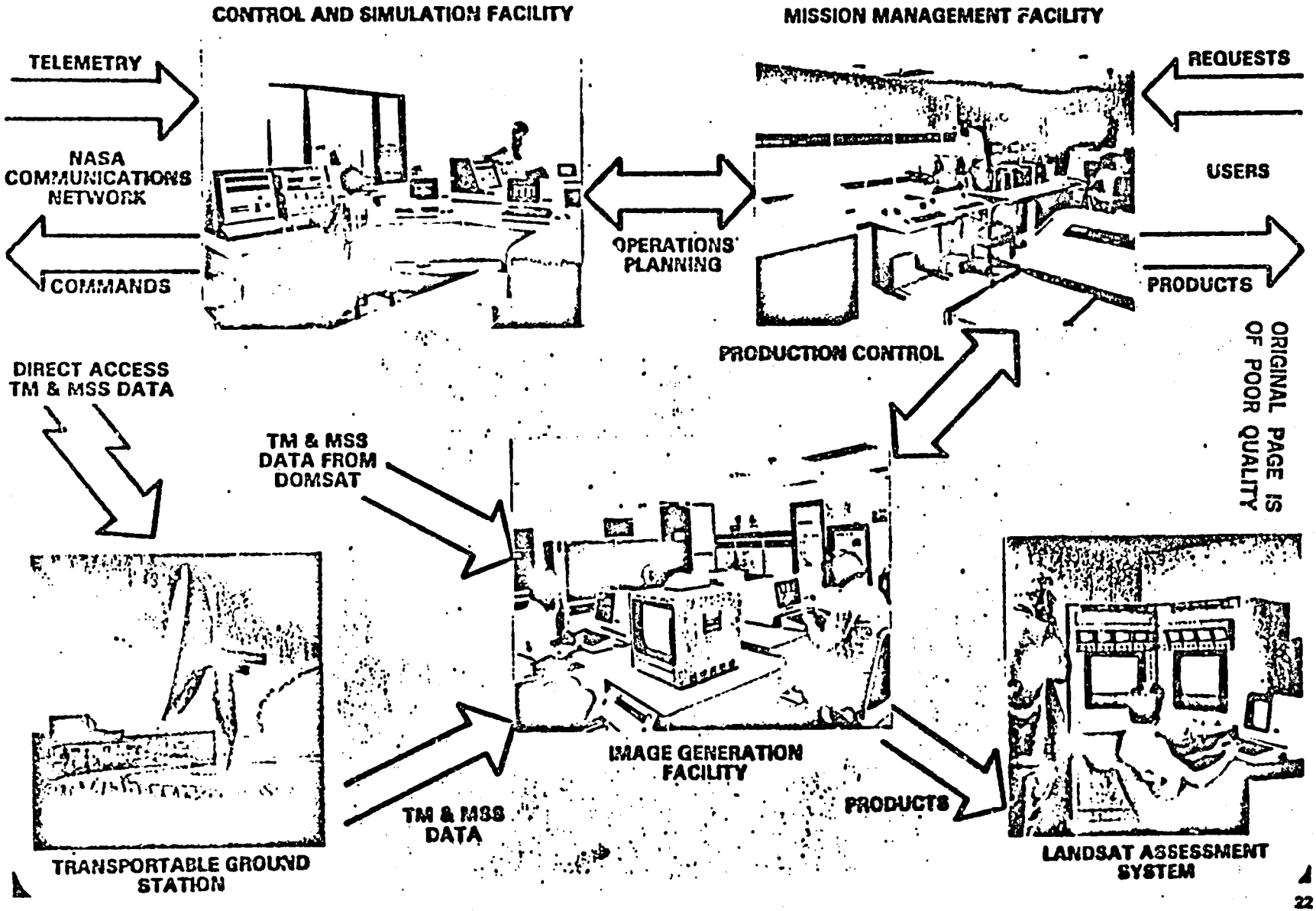
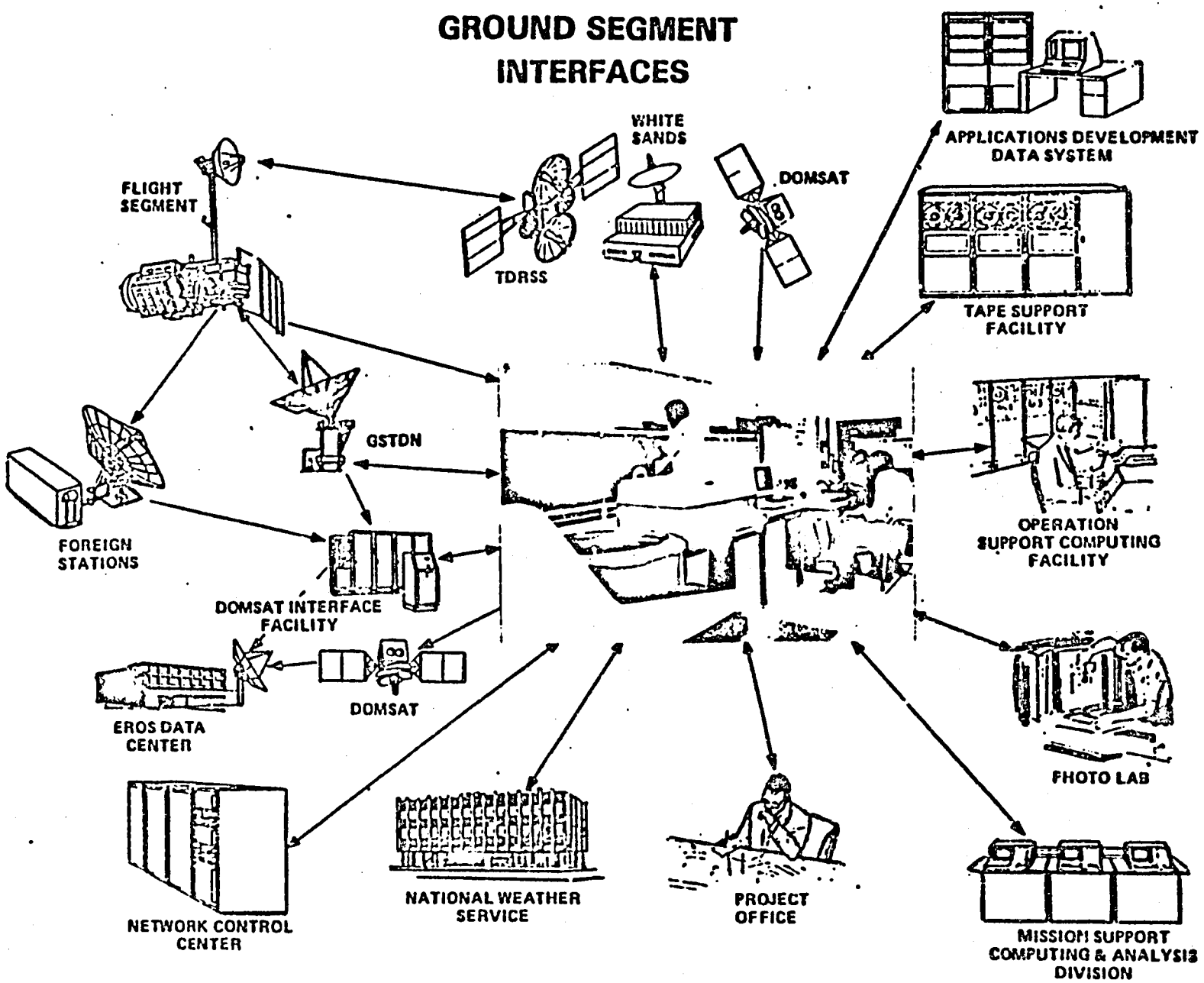


Ground Segment Summary

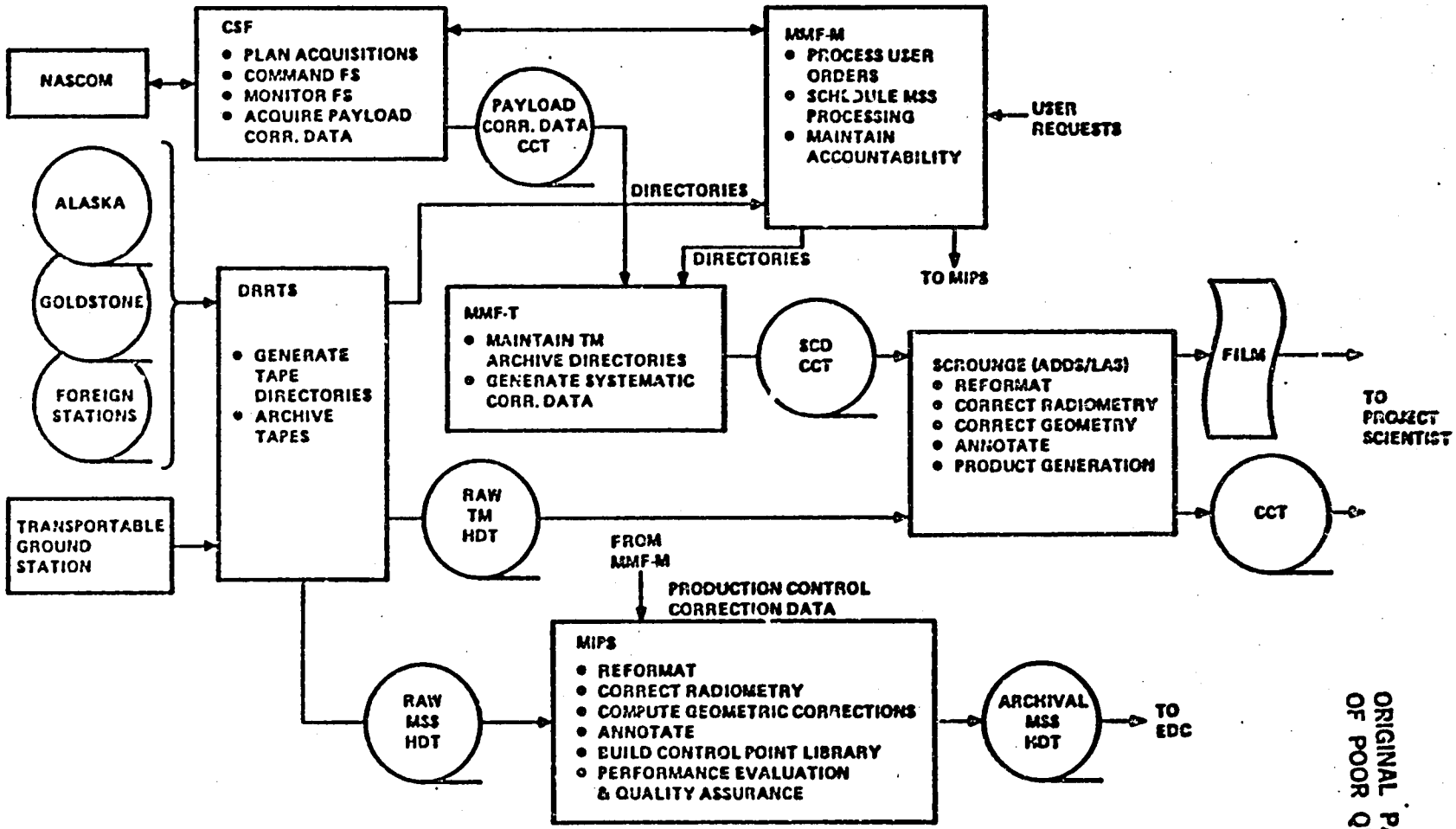
LANDSAT D
MSS GROUND SEGMENT



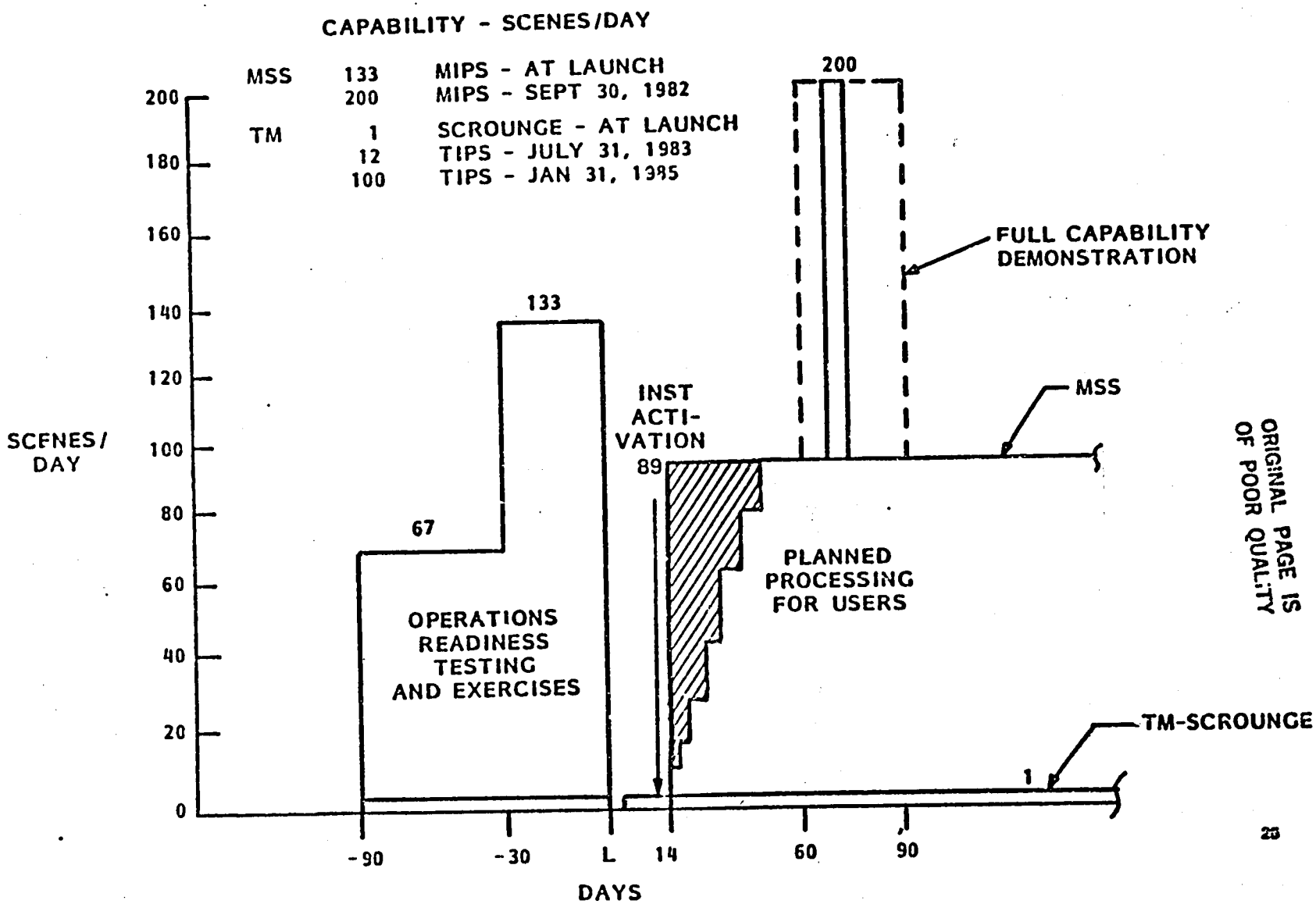
GROUND SEGMENT INTERFACES



Initial Ground Data Flow



Processing


CAPABILITY - SCENES/DAY
MSS 133 MIPS - AT LAUNCH
200 MIPS - SEPT 30, 1982
TM 1 SCROUNGE - AT LAUNCH
12 TIPS - JULY 31, 1983
100 TIPS - JAN 31, 1985
SCENES/ DAY
200
180
160
140
120
100
80
60
40
20
0
200
133
67
89
1
FULL CAPABILITY DEMONSTRATION
MSS
INST ACTI- VATION
PLANNED PROCESSING FOR USERS
OPERATIONS READINESS TESTING AND EXERCISES
TM-SCROUNGE
-90
-30
L
14
60
90
DAYS
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Data Distribution

MSS OUTPUT	NAME	USE	VOLUME (SCENES/DAY)	
			CAPABILITY	PLAN
HIGH DENSITY TAPE — ARCHIVAL	HDT-AM	USER PRODUCT	200	89
COMPUTER COMPATIBLE TAPE-ARCHIVAL	CCT-AM	USER PRODUCT**, PERFORMANCE EVALUATION & LAS	TOTAL OF 2	TOTAL OF 2
COMPUTER COMPATIBLE TAPE-PRODUCT	CCT-PM	USER PRODUCT**, PERFORMANCE EVALUATION & LAS		
241 MM FILM-ARCHIVAL	F241-AM	PERFORMANCE EVALUATION	TOTAL OF 4	TOTAL OF 4
241 MM FILM-PRODUCT	F241-PM	PERFORMANCE EVALUATION & LAS		
70 MM FILM-ARCHIVAL	F70-AM	PERFORMANCE EVALUATION	200(IN ONE BAND)	89

** NOT PLANNED FOR EXTERNAL DISTRIBUTION

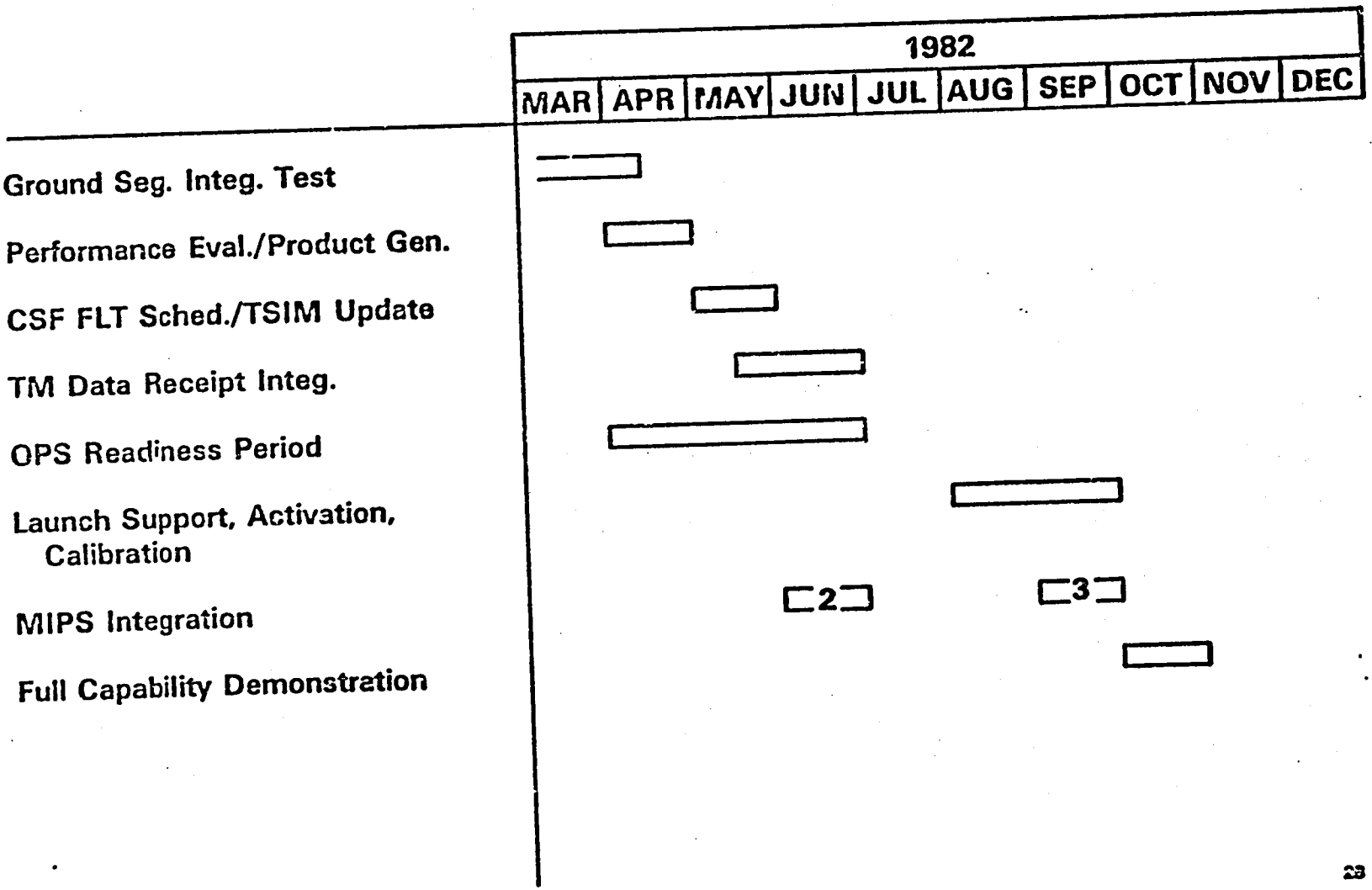
SCROUNGE OUTPUT	NAME	USE	VOLUME (SCENES/DAY)	
			CAPABILITY	PLAN
241 MM FILM-ARCHIVAL	F241-AT	SCIENCE OFFICE; AN USERS*; EROS DATA CENTER*	1	1
241 MM FILM-PRODUCT	F241-PT	SCIENCE OFFICE; AN USERS*; EROS DATA CENTER*	1	1
COMPUTER COMPATIBLE TAPE-PRODUCT	CCT-PT	SCIENCE OFFICE; AN USERS*; EROS DATA CENTER*	1	1

* SELECTED SCENES

Performance

REQUIREMENT	MSS PROCESSING SYSTEM	SCROUNGE
TURNAROUND TIME	48 HOURS MAXIMUM • RAW DATA TO ARCHIVAL HIGH DENSITY TAPE • WITH ANY SINGLE POINT FAILURE	NOT APPLICABLE
MAXIMUM UTILIZATION	85% OF 16 HOUR DAY	100% OF 8 HOUR DAY
RADIOMETRIC ACCURACY	±1 QUANTUM LEVEL	CONSISTANT WITH CURRENT ALGORITHM DEFINITION
MAP PROJECTIONS	SPACE OBLIQUE MERCATOR UNIVERSAL TRANSVERSE MERCATOR/POLAR STEREOGRAPHIC	SPACE OBLIQUE MERCATOR UNIVERSAL TRANSVERSE MERCATOR
RESAMPLING ALGORITHMS	CUBIC CONVOLUTION NEAREST NEIGHBOR	CUBIC CONVOLUTION
GEOMETRIC ACCURACY • TEMPORAL REGISTRATION • GEODETIC	0.3 PIXEL (90% OF THE TIME) 0.5 PIXEL (90% OF THE TIME)	CONSISTENT WITH CURRENT ALGORITHM DEFINITION

Ground Segment Tasks



III. Mission Requirements and Management

A. Mission Requirements

B. Operational Mission Management

A. Mission Requirements

- User Community
- User Requirements
- Acquisition/Processing Plan
- Priority Allocation
- Landsat-3/D Overlap Plan

User Community (Domestic)

- **Large Users:**
  - Johnson Space Center (JSC)
  - U.S. Department of Agriculture (USDA)
  - Defense Mapping Agency (DMA)
  - Other
- **General Users:**
  - U.S. Geological Survey
  - National Oceanic and Atmospheric Administration (NOAA)
  - Private Industry (ERIM, IBM, EARTHSAT, GEOSPECTRA, EXXON, ARCO, etc.)
  - University (Purdue, Arizona, Stanford, Dartmouth, etc.)
  - Project (Hughes, GE, Code 900, Code 435, Code 700)
  - States
- **Applications Notice:** 24 Selected by GSFC — Headquarters Approval Pending

User Community
(FOREIGN GROUND STATIONS)

Country	Memorandum of Understanding Expiration Status
ARGENTINA	30 September 1983
AUSTRALIA	9 January 1983*
BRAZIL	29 March 1983
CANADA (2)	30 September 1983
ITALY	9 May 1982*
INDIA	9 May 1983
JAPAN	29 January 1983*
SOUTH AFRICA	30 September 1983
SWEDEN	9 May 1982*
THAILAND	9 May 1984
INDONESIA	30 September 1983
CHINA	24 January 1984
ROMANIA	30 September 1983

* Code LI Plans to Extend, Not Renegotiate, for NASA Period of Responsibility

User Requirements

Multispectral Scanner (MSS)
ACQUISITION REQUIREMENTS

- U.S. Requirements (Scenes Per Cycle) for Domestic Use:

575	— Continental U.S.
125	— Alaska
100–200	— Remainder of North America (Canada, Mexico, etc.)
800–900	

- Foreign Acquisition Requirements (Scenes Per Cycle) — Domestic U.S. Processing:

80	— Australia
200	— Sweden
115	— Japan
130	— Brazil
525	

- Agristars Acquisition (U.S. & Foreign)

800–1200 — Varies From Fall/Winter to Spring/Summer

Multispectral Scanner (MSS) (Continued)
ACQUISITION REQUIREMENTS MET

- **Pre-TDRSS**

U.S.	800–900 (Includes 250 for Agristrars)
Foreign	525 (Excluding 450 for Agristrars)
Total Unique	1325–1425 (Scenes Per Cycle)

- **Post-TDRSS**

U.S.	800–900
Foreign	975 (Includes Agristrars Requirement)
Total Unique	1775–1875 (Scenes Per Cycle)
	+125 Miscellaneous Additional Scenes
	1775–2000 (Scenes Per Cycle)

Thematic Mapper (TM)

Requirements	Scenes Per Cycle	
	Pre-TDRSS/TIPS	Post-TDRSS/TIPS*
Applications Notice and Engineering Analysis	16	16
Agristars	2–3	8
		110
Estimated Total Unique Scenes	16	Approximately 140

* Post-TDRSS/TIPS but Prior to 1985

Acquisition/Processing Plan

U.S. Ground Station Coverage

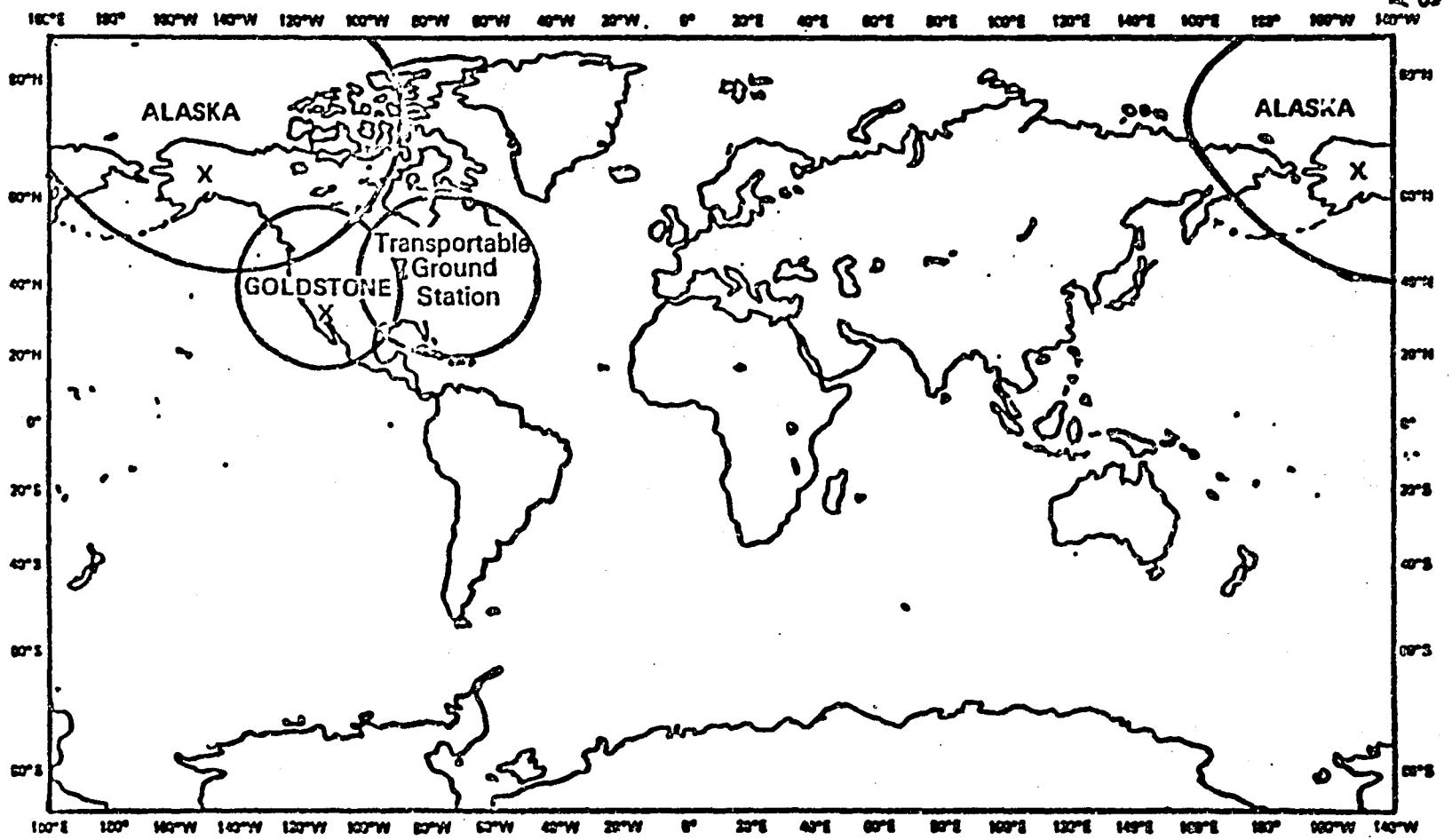


IMAGE ACQUISITION STATION

U.S. Ground Station Acquisition Capabilities by Station at 5° Antenna Angle

(LAND MASS SCENES* PER 16-DAY CYCLE)

	Total Coverage	With Apportioned Overlap	
		MSS	TM
Greenbelt Transportable Ground Station	501	252	501
Goldstone (MSS Only)	452	240	
Fairbanks (MSS Only)	436	408	
Total Unique Scenes		900	501

*— Includes Scenes Between 80 Degrees (N/S) Latitude Without Concern for Sun Angle
— Incudes Scenes Overlapping with Foreign Coverage
— Excludes All Large Water Bodies Except Coastal-Zone Scenes

Acquisition/Processing Plan

(U.S. REQUIREMENTS)

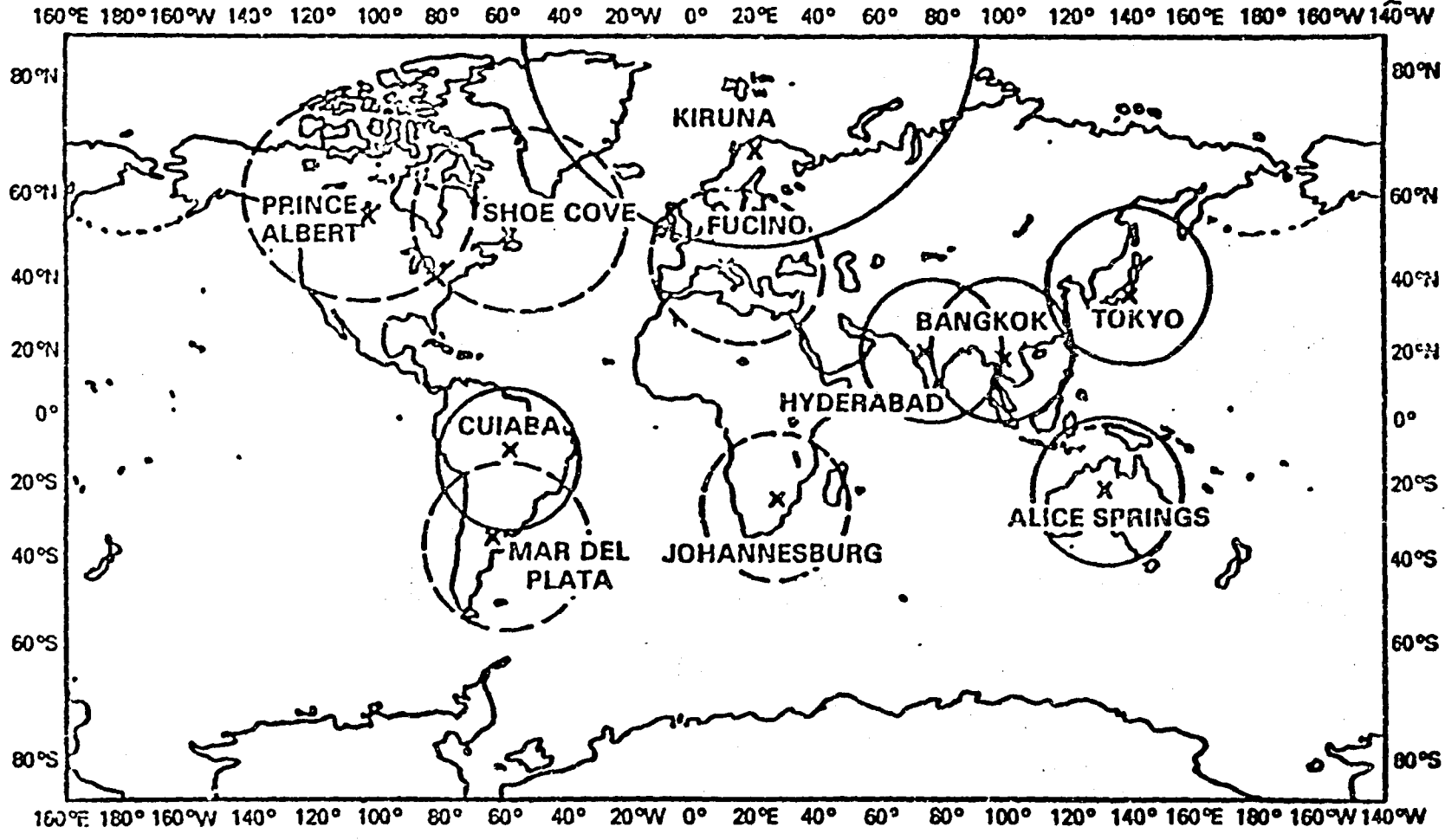
- NASA Acquisition:

	Scenes Per Day		
	MSS	TM(Day)	TM(Night)
Transportable Ground Station (TGS)	16	30	As Required
Goldstone	15		
Alaska	25		
Australia	5		
Brazil	8		
ESA/Sweden	13		
Japan	7		
Total	89	30	As Required
	↓	↘	↓
	89		1

- NASA Processing
- NASA Archive to Protect Against Early Failure of TM Acquisition Capability

Foreign Ground Station Coverage

at Landsat-D Launch



Foreign Ground Station (FGS)

FGS With US Recorder

Landsat D Foreign Ground Station Acquisition Capabilities by Station at 5° Antenna Angle

(LAND MASS SCENES* PER 16-DAY CYCLE)

	1982		1983		1984	
	Total Coverage	With Apportioned Overlap	Total Coverage	With Apportioned Overlap	Total Coverage	With Apportioned Overlap
Argentina	206	115	206	115	206	115
Australia (NR)	435	435	435	435	435	403
Brazil (NR)	547	456	547	456	547	456
Canada—Prince Albert	827	392	827	392	827	392
Canada—Shoe Cove	311	159	311	159	311	159
China	—	—	694	485	694	485
ESA—Italy	445	359	445	203	445	203
ESA—Sweden (NR)	480	414	480	361	480	361
India—Hyderabad	269	90	269	87	269	74
Indonesia	—	—	—	—	209	135
Japan (NR)	281	271	281	173	281	173
Romania	—	—	506	290	506	290
South Africa	368	368	368	368	368	368
Thailand	442	344	442	259	442	220
Total Unique Scenes		3,403		3,783		3,834

* — Includes Scenes Between 80 Degrees (N/S) Latitude Without Concern for Sun Angle.
— Includes Scenes Overlapping U.S. Coverage.
— Excludes All Large Water Bodies Except Coastal-Zone Scenes.
— (NR) NASA Recorder Location.

Acquisition Plan
(FOREIGN GROUND STATIONS)

	Scenes Per 16 Day Cycle	
	MSS	TM* Operational Capability Data
Argentina	206	Late 83
Australia	435	TBD
Brazil	547	July 82
Canada/Prince Albert	827	July–Sept 82
Canada/Shoe Cove	311	July–Sept 82
ESA/Italy	445	June–Sept 82
ESA/Sweden	480	June–Sept 82
India	269	July 82
Japan	281	August 82
South Africa	368	TBD
Thailand	442	TBD

*Beginning Date for Foreign Ground Station TM Acquisition Presently Under Review by NASA Headquarters

Priority Allocation

- Acquisition

MSS		TM	
Level	Use	Level	Use
0–9	Reserved for Project and Science Office	0–100	Assigned by Science Office
10–99	Assigned by EDC		

- Processing

MSS		TM	
Level	Use	Level	Use
0	Disaster/Special Priority		Addressed in Section VIII of MOR
99	Routine		
1–98	Reserved for Backlog Management		

Landsat-3/D Overlap Plan

- Landsat-3 Active Through March 1983 Then Placed in Standby Mode Through September 1984 With Provision for 30/60 Day Recall
- Science Office/Missions Utilization Office Administers Requirements for Landsat 3 and Monitors Requirements from EDC for Landsat-D
- Priority Assignment for Housekeeping and Image Data Collection:
  - Housekeeping — Landsat-D
  - Image Data Collection — Landsat-D Unless Otherwise Specified by Science Office
- Instrument Data (Through GSTDN) Handled by Domsat Interface Facility (DIF)
- Combined Mission MSS Allocation:

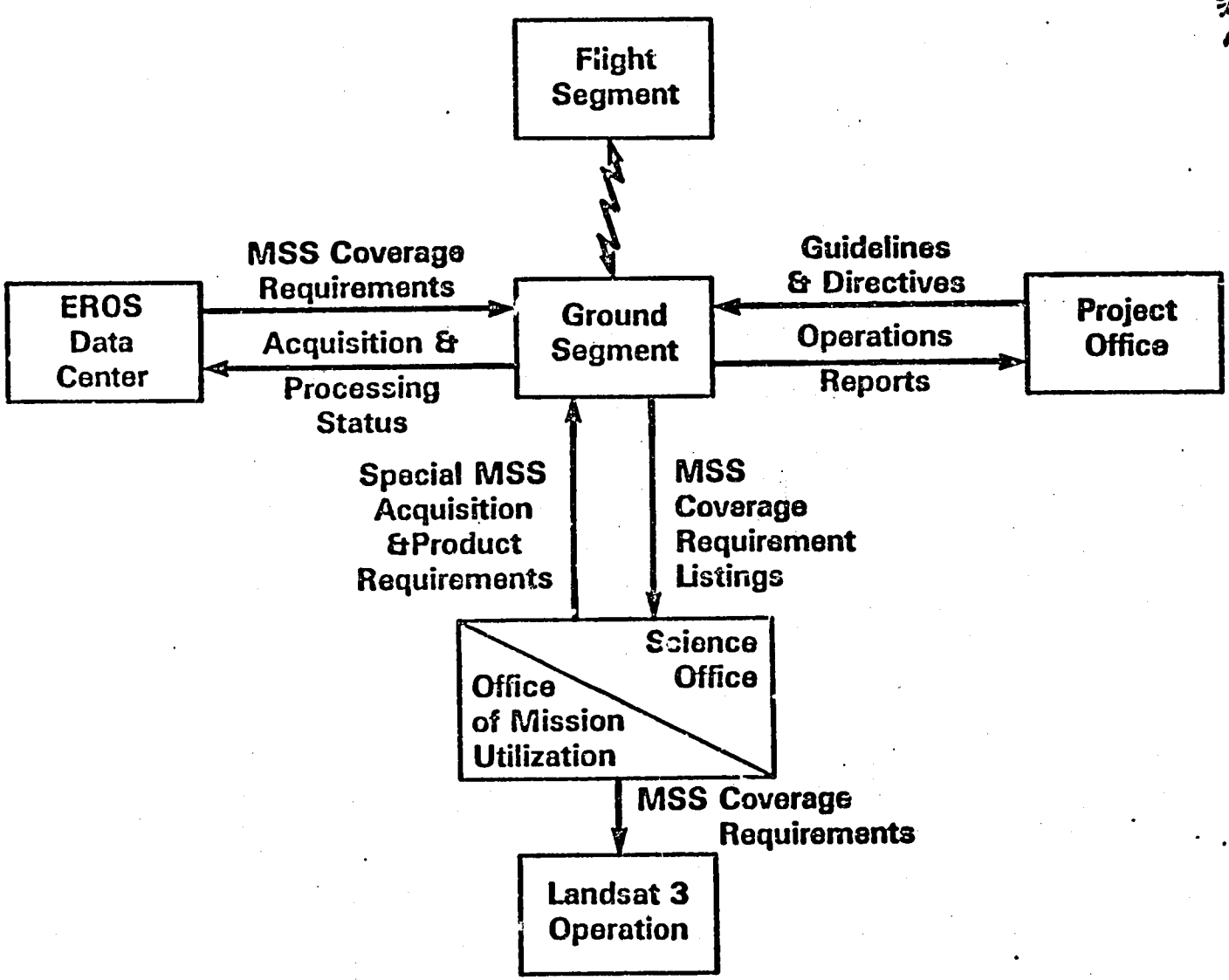
Landsat-3 —	75–107
Landsat-D —	89
Total	164–196*

* Within Capacity of Domsat 20MB Service Lease Period of 7 Hours/Day

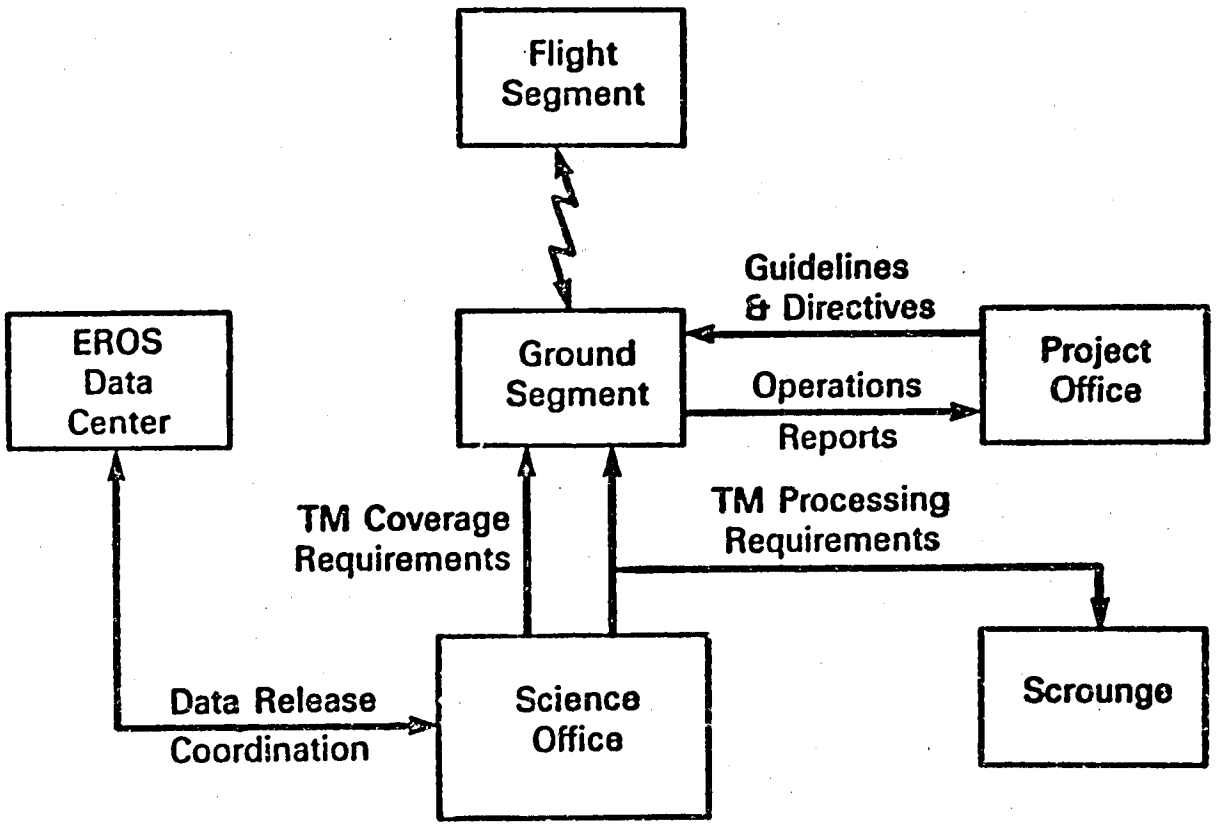
Operational Mission Management

- Management Interfaces
- Mission Activity Scheduling
- EDC Order/Status Interface
- Science Office Requirements Interface
- Project Office Management Interface

Operational Management Interfaces—MSS Mission



Operational Management Interfaces—
TM Mission



Mission Activity Scheduling

Data Acquisition:

(1) Advanced Planning Every Weekend (7 - 14 Day Lead)

(2) Routine Daily Scheduling (12 - 36 Hour Lead)

(3) Dynamic Rescheduling as Required

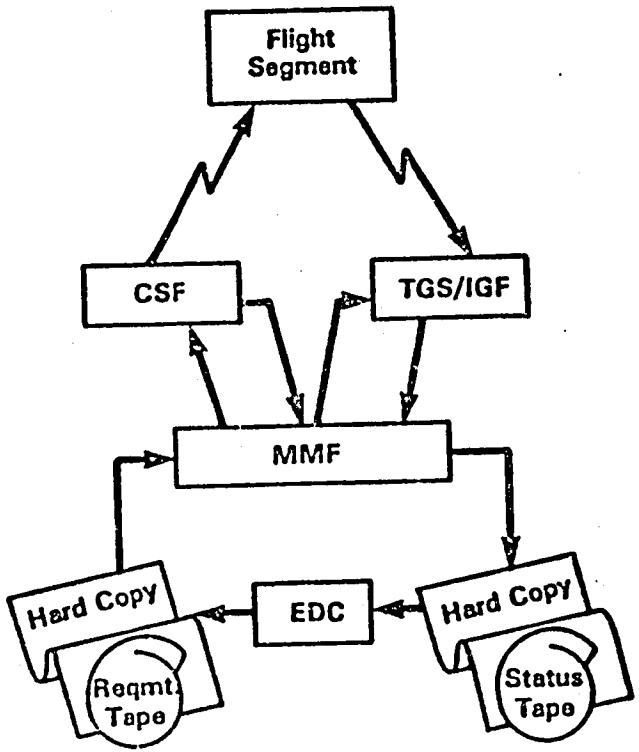
Data Processing (MSS)

(1) At Regular Intervals Throughout Day

(2) Upon Receipt of New Input Data

(3) Re-ordering of Work In Queue Possible at Each Processing Line

EDC Order/Status Interface



- User Information
- MSS Acquisition Orders

- Order Confirmation
- Production Status
  - Acquisition Scheduled
  - Data Acquired
  - Processing Begun
  - Data Transmitted to EDC

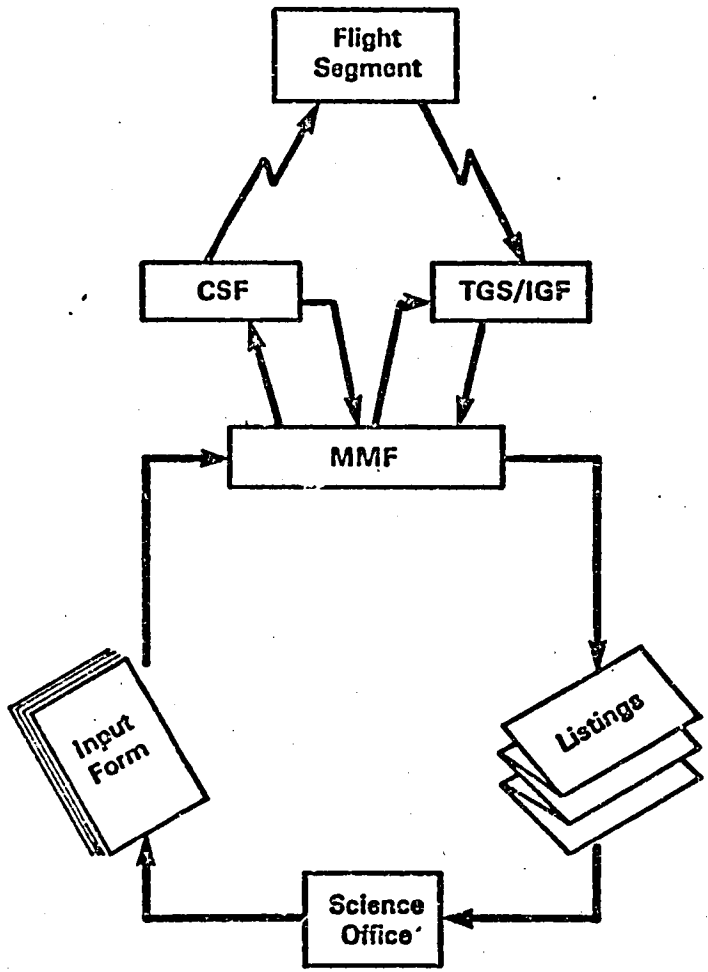
Acquisition & Product Orders

- Weekly Input Tape
- Hardcopy as Required

Status Feedback

- Weekly, Following Tape Input
- Inquiries Via Hardcopy, as Required

Science Office Requirements Interface



Special Requirements:

Hardcopy Inputs as Required

- Special Coverage
- Direct Output Products

Coverage Listings:

Hardcopy Outputs Following EDC Inputs or as Requested

- Summary Coverage Maps
- Detailed Coverage Request Lists

User Data Entry and Update

LANDSAT-D USER INFORMATION FORM

USER ID: 800248 TYPE: (F)OREIGN/(D)OMESTIC

NAME: Lyons, Walter A., Dr. NEW USER ✓ UPDATE _____

(CHECK ONE)

AGENCY/ORGANIZATION: OTHR STATUS: Active

MAILING ADDRESS:

LINE 1: 345 University Ave. SE

LINE 2: Minneapolis, Minn. 55414

LINE 3: _____

SHIPPING ADDRESS:

LINE 1: Same as Above

LINE 2: _____

LINE 3: _____

Standing Order Request

USER ID: 800248
MISSION-TYPE 0, 4 OR 5 4

SUN ANGLE: 10
DATE SPAN(YYDDD): START: 82216
STOP: 82330

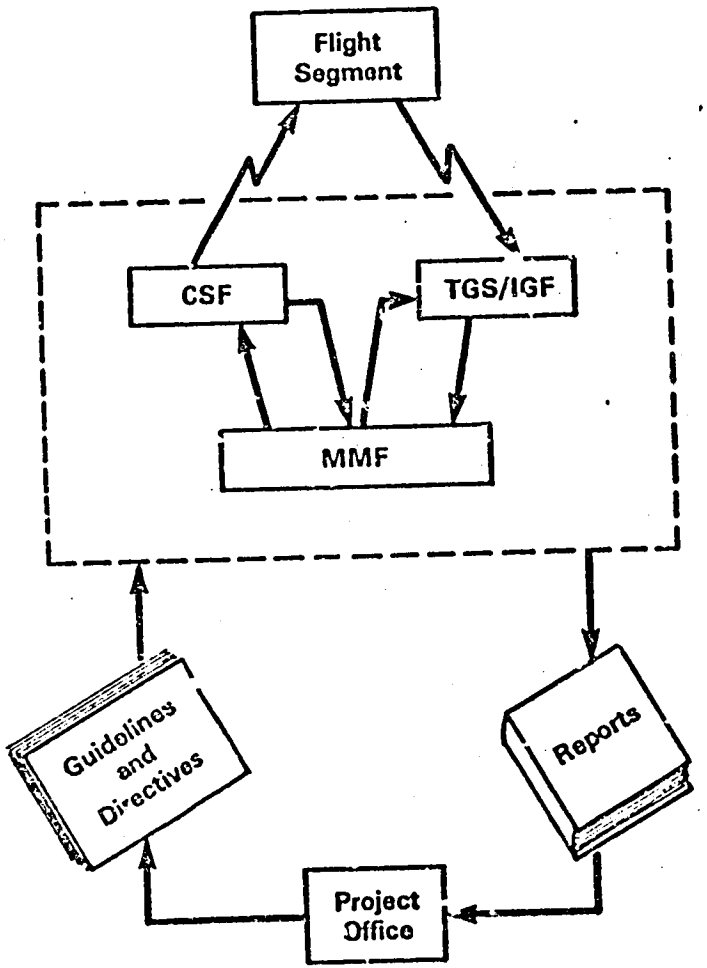
ACQUISITION
ACQUISITION HITS: 3
ACQUISITION PRIORITY: 9
ACCEPTABLE CLOUD COVER: 50

AREA: BLOCK - PATH 22 ROW 30
SEGMENT - PATH __ ROW __
(MULTIPLE AREA ENTRIES ALLOWED)

USER TYPE (1,-DOMESTIC, 2-FOREIGN): 1
SENSOR (1-TM, 2-MSS): 2
IF MSS: GAIN L
MODE C
RECEIVING STATION: _____

PRODUCT
PRODUCT HITS: _____
COPIES DESIRED: _____
PRODUCT PRIORITY: _____
ACCEPTABLE CLOUD COVER: _____
PRODUCT CODE: ____
ACCEPTABLE QUALITY (0-9): _____
PATH 20 ROW 26
TO ROW ____

Project Office Management Interface



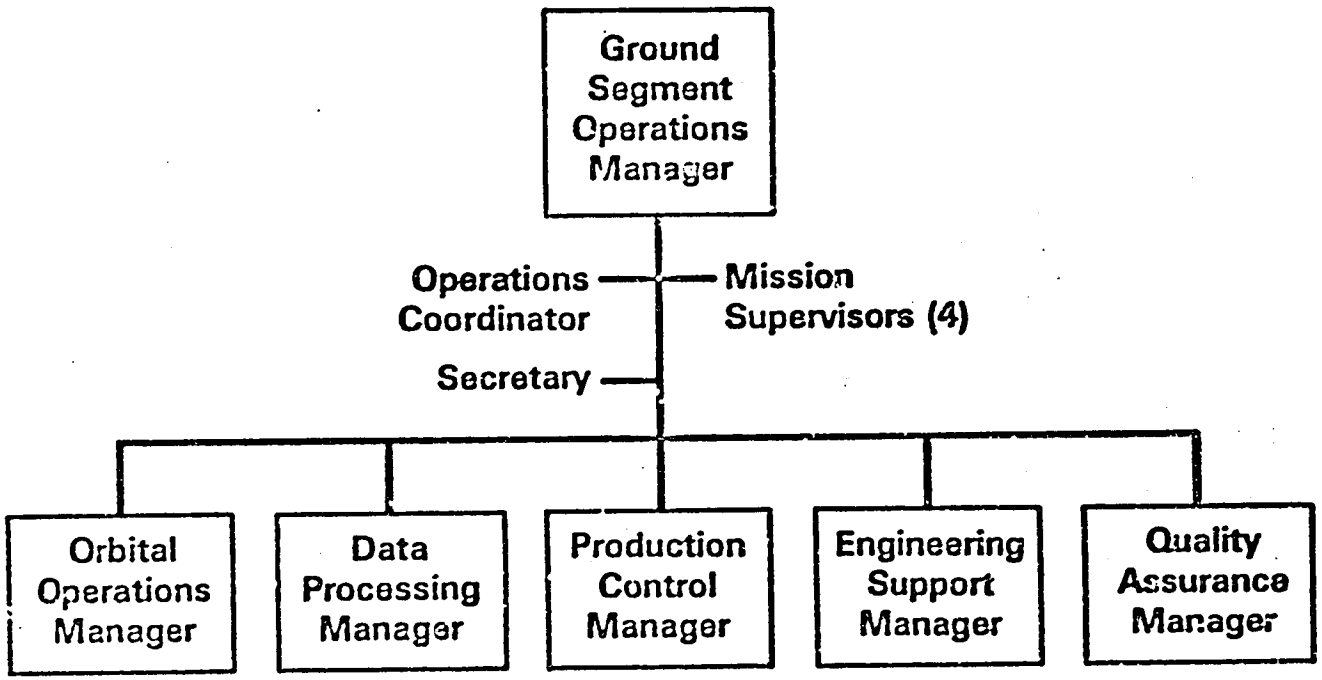
Guidelines and Directives:

- Ground Rules for Conducting Day-to-Day Activities
- Specific Actions to be Taken
- Direct Control of System Elements

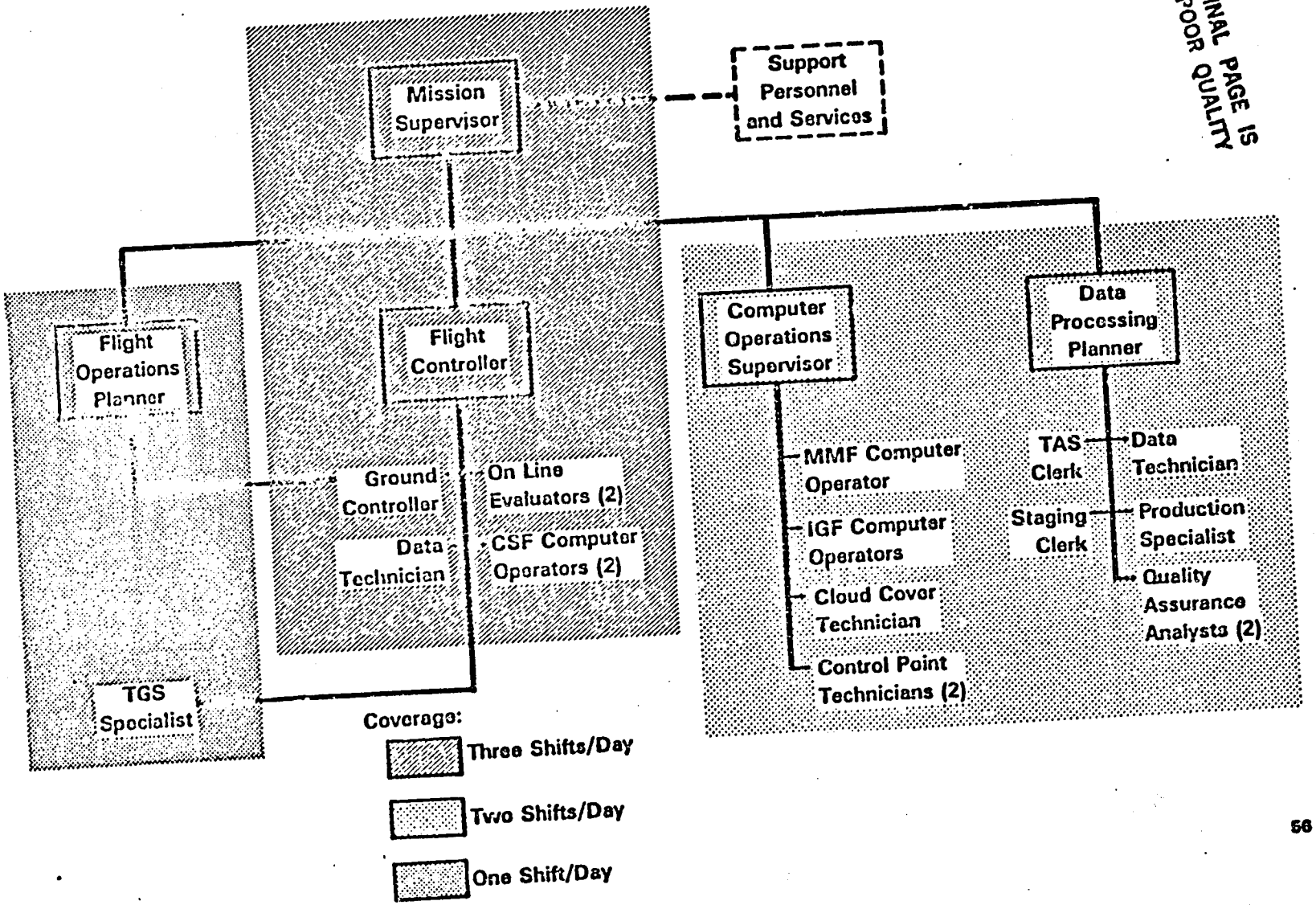
Reports:

- Regular Summaries of Mission Operations
- Provided — Daily
  — Weekly
  — Monthly/Quarterly

Operational Management Organization



Work—Shift Management



Operational Guidelines

<u>Acquisition:</u>

- Number of Scenes Per Day—MSS
  —TM
- Conflict Resolution—Landsat 3 Vs. Landsat D
  —MSS Operating Mode
- Foreign Ground Station Authorization

<u>Processing:</u>

- Utilization of Priorities
- Retrospective Order Handling
- Number of Shifts/Day
- Control Point Selection Priorities
- Rework
- Data Archive
- Quality Control

Landsat-D Operational System
Project Office Directive

DATE: 15 August, 1982

SYSTEM ELEMENT: All

DIRECTIVE: Initiate operational data acquisition and processing operations

EFFECTIVE PERIOD: Until further notice

ACTION REQUIRED:

____ Assess impact, plan implementation and report; do not execute.

____ Assess impact, plan implementation and execute.

✓ Execute as stated; no impact assessment required.

PREPARED BY: W. Webb DATE: 8/14/82

APPROVED BY: W. Webb DATE: 8/14/82

Mission Operations Manager

RECEIVED BY: _____ DATE: _____

CS

Daily Activity Report—Description

FORMAT	CONTENT
I. System Status A. Flight Segment B. Ground Segment (by Facility) C. Supporting Systems	• Status at 2400 • Equipment In-Service Totals
II. Activity Summary A. Data Acquisition B. Data Processing C. Product Generation and Distribution	(1) Attempted (2) Accomplished (3) Cumulative Totals
III. Priority Task Status [Entry for Each Priority Task Underway]	• Task Identification (Sponsor/Priority/Due Date) • Current Status • Projected Disposition
IV. Significant Events or Problems	• Content as Appropriate
V. Activity Projection A. Data Acquisition B. Data Processing C. Product Generation and Distribution D. Non-Production Activities E. Special Events	• Content as Appropriate

Daily Activity Reporting—Features

- Compiled by: Mission Supervisor
- Inputs From: Each Line Manager (or Representative)
- Coverage: 24-Hour Period
  (0000 - 2400 Local)
- Issued: Daily, by 10 AM on the Following Day
- Distribution: Mission Operations Manager
  Project Science Office
  Ground Segment Operations Manager
  Each Line Manager

Periodic Summary Report—Description

FORMAT	CONTENT
I. Key Events A. Requirements B. Capabilities C. Guidelines and Directives	(1) In the Reporting Period (2) Projected
II. Problems and Impacts A. Flight Segment B. Ground Segment (by Facility) C. Supporting Systems	• Content as Appropriate
III. Operation Summary and Statistics A. Data Acquisition B. Data Processing C. Product Generation and Distribution	• Compilation of Data From Daily Reports— (1) Graphic (2) Tabular
IV. Capability Assessment A. Equipment B. Personnel C. Support Services	• Content as Appropriate

Periodic Summary Report—Features

- Compiled by: Ground Segment Operations Manager
- Inputs From: (1) Mission Supervisors
  (2) Each Line Manager
  (3) Interface Support Management

	WEEKLY	MONTHLY	QUARTERLY
• Coverage:	Monday Through Sunday	Each Calendar Month	January—March April—June July—September October—December
• Issued:	Following Tuesday	Within 10 Days (Superceded by Quarterly)	Within 15 Days
	Mission Operations Management	Project Management	Project Management

IV. Flight Operations

A. Data Acquisition Plan
B. Control and Simulation Facility (CSF) Overview
C. External Interfaces
D. Flight Segment Operations
E. Control Center Operations

Data Acquisition Plan

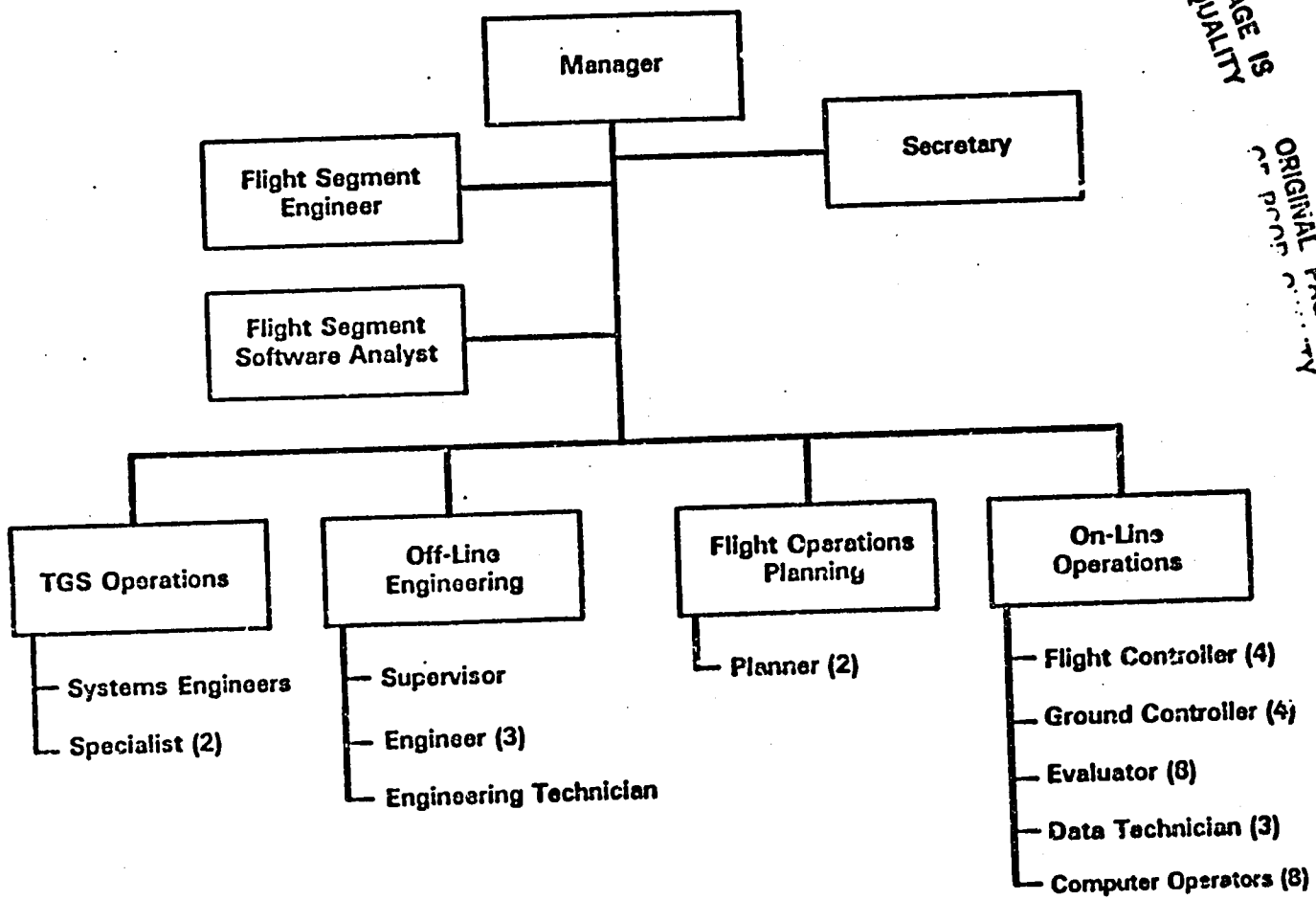
	SCENES PER DAY MSS	TM/DAY	TM/NIGHT
(1) NASA Acquisition:			
— TGS	16	30	A/R
— Goldstone	15	—	—
— Alaska	25	—	—
— Australia	5	—	—
— Brazil	8	—	—
— ESA/Sweden	13	—	—
— Japan	7	—	—
	89	30	
(2) Foreign User Acquisition/Processing:			
— Argentina	13	—	—
— Australia	27	—	—
— Brazil	34	—	—
— Canada/Pr Albert	52	—	—
— Canada/Shoe Cove	19	—	—
— ESA/Italy	28	—	—
— ESA/Sweden	30	—	—
— India	17	—	—
— Japan	18	—	
— South Africa	23	—	
— Thailand	28	—	
	289		

CSF Overview

- Organization
- Facilities
- Hardware
- Software
- CSF Activities Overview

Organization

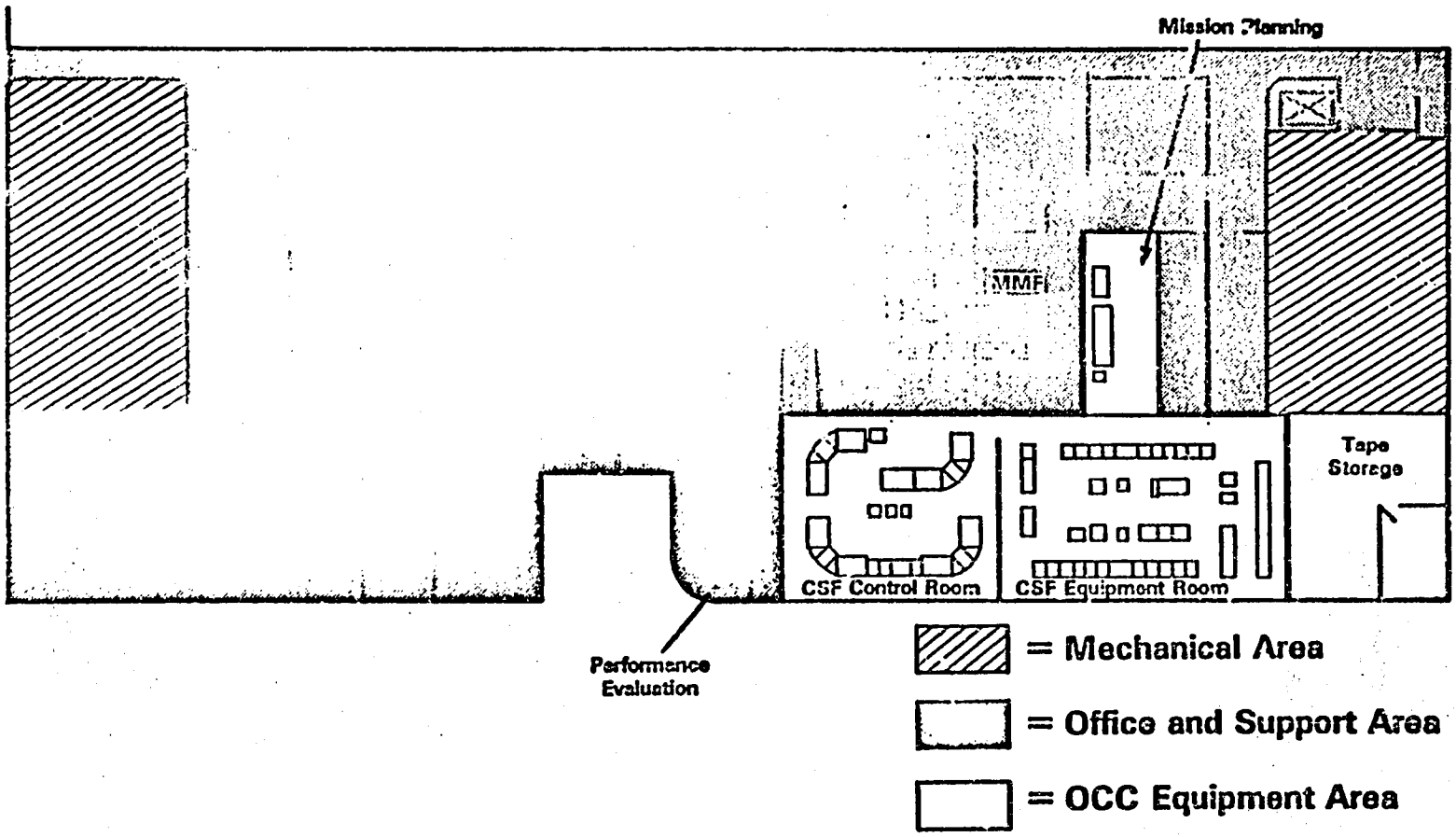
CSF Orbital Operations



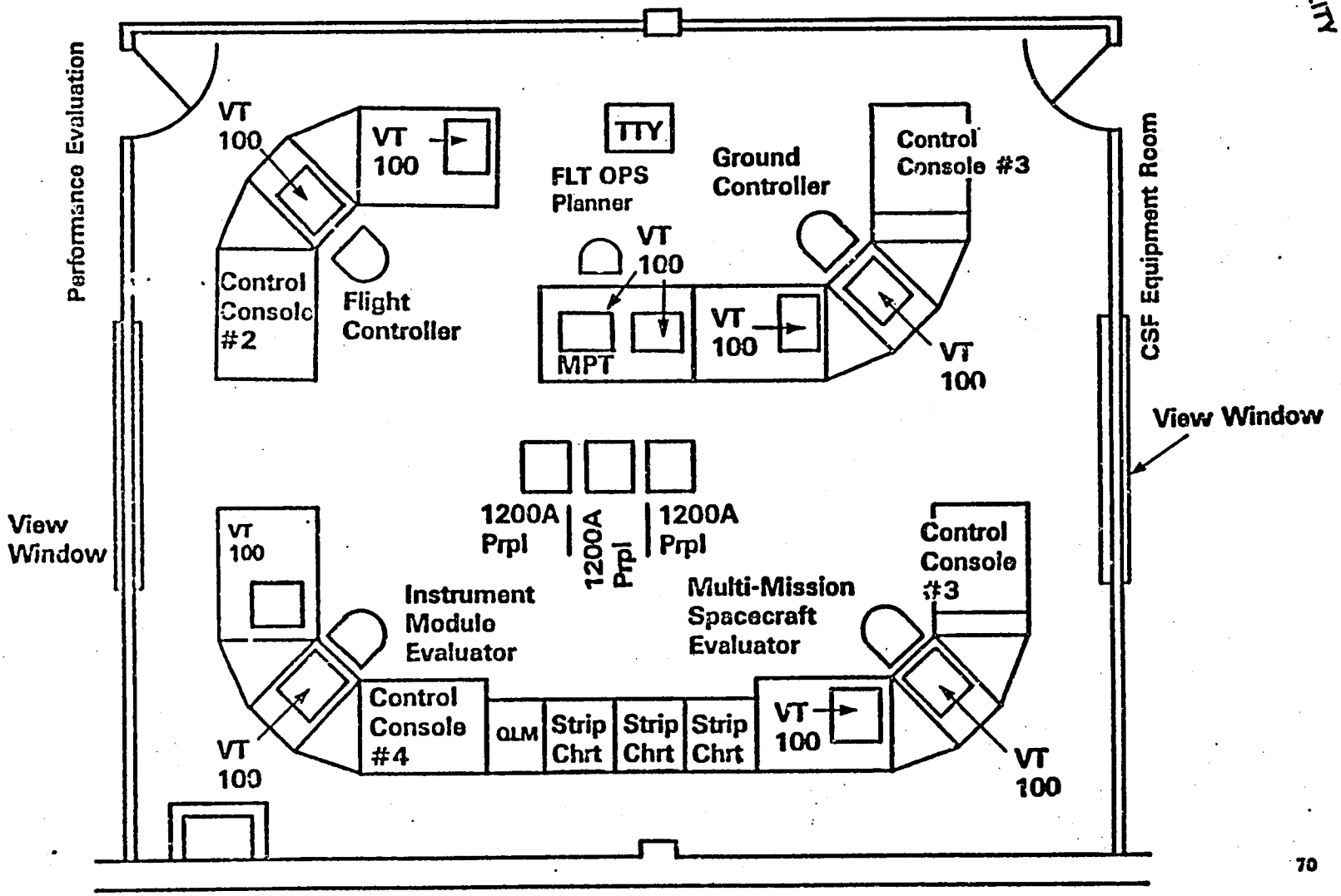
Total = 41

Facilities

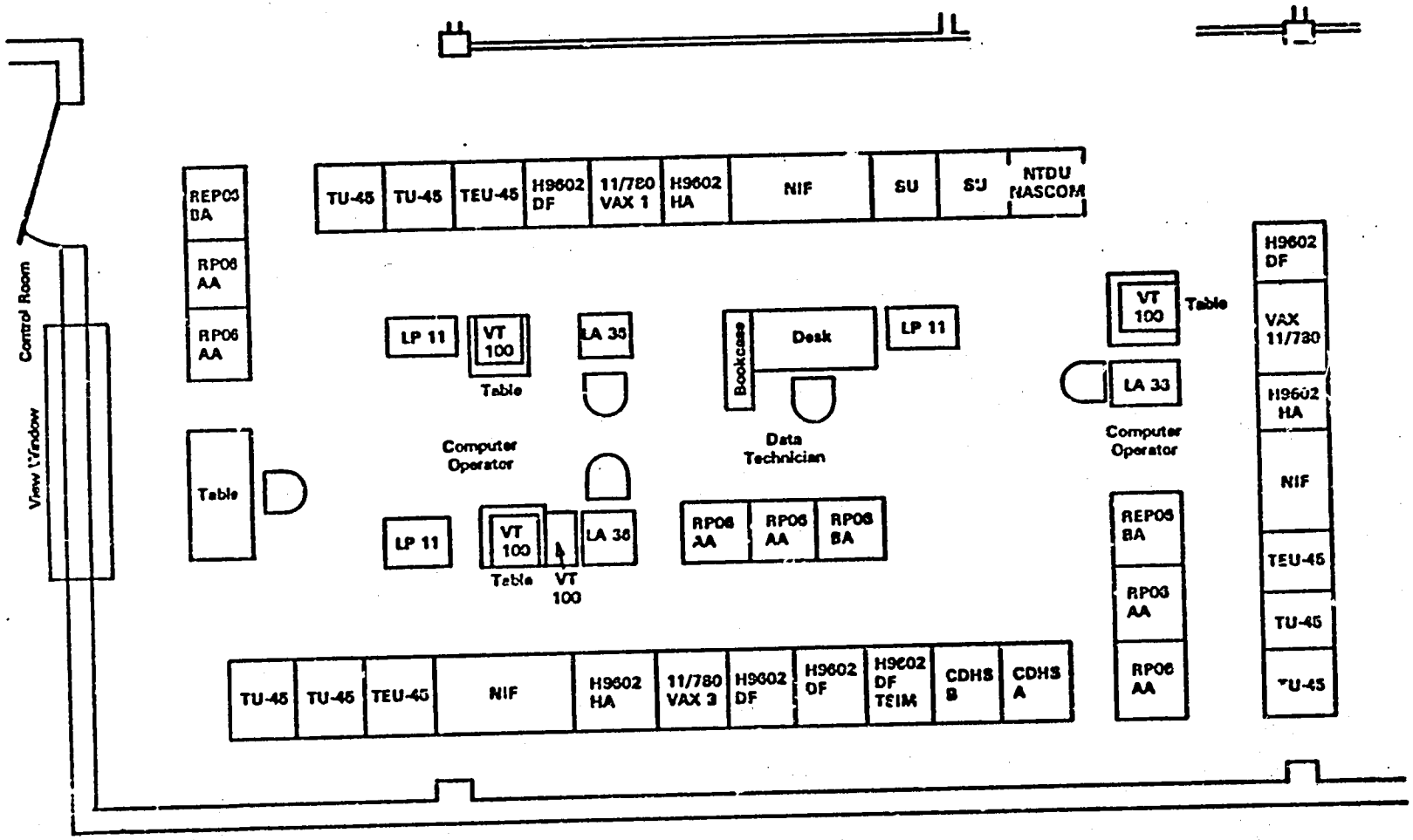
Goddard Space Flight Center
Building 28 — Wing A
Landsat-D Ground Segment Facility
Second Floor



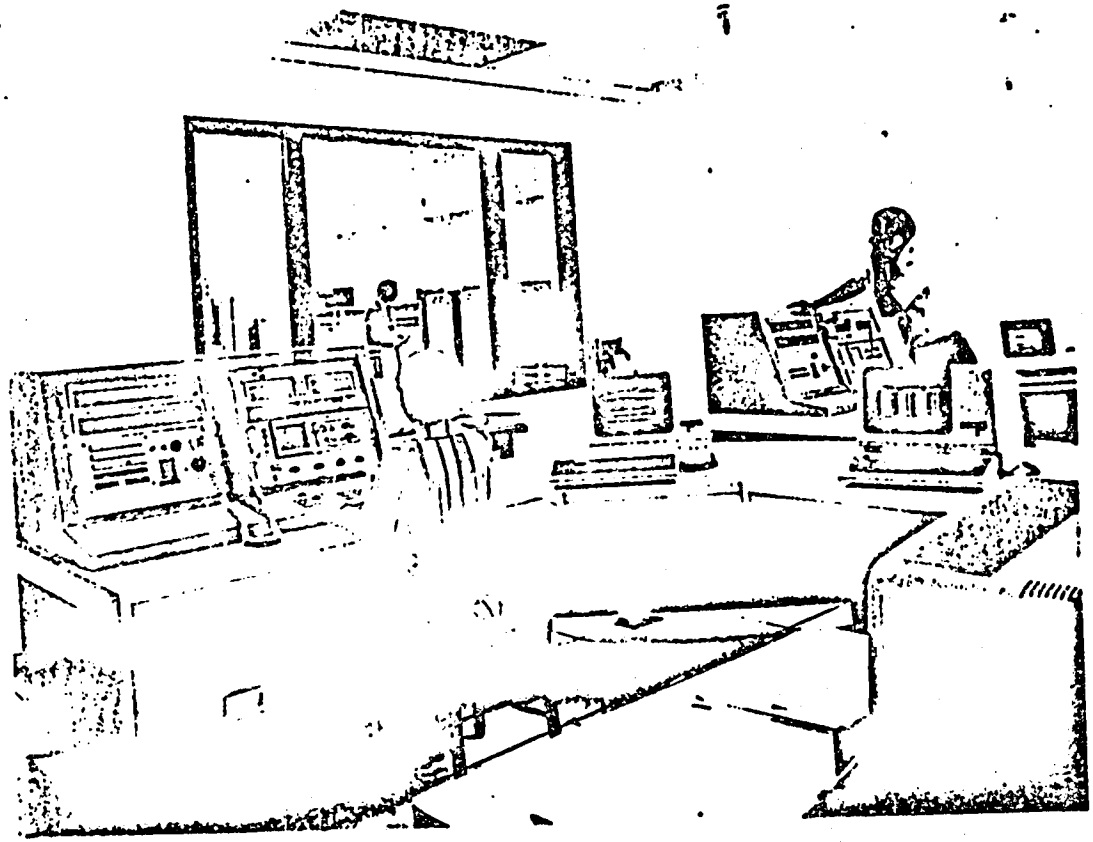
Control and Simulation Facility (CSF)
Control Room



Control and Simulation Facility (CSF)
Equipment Room

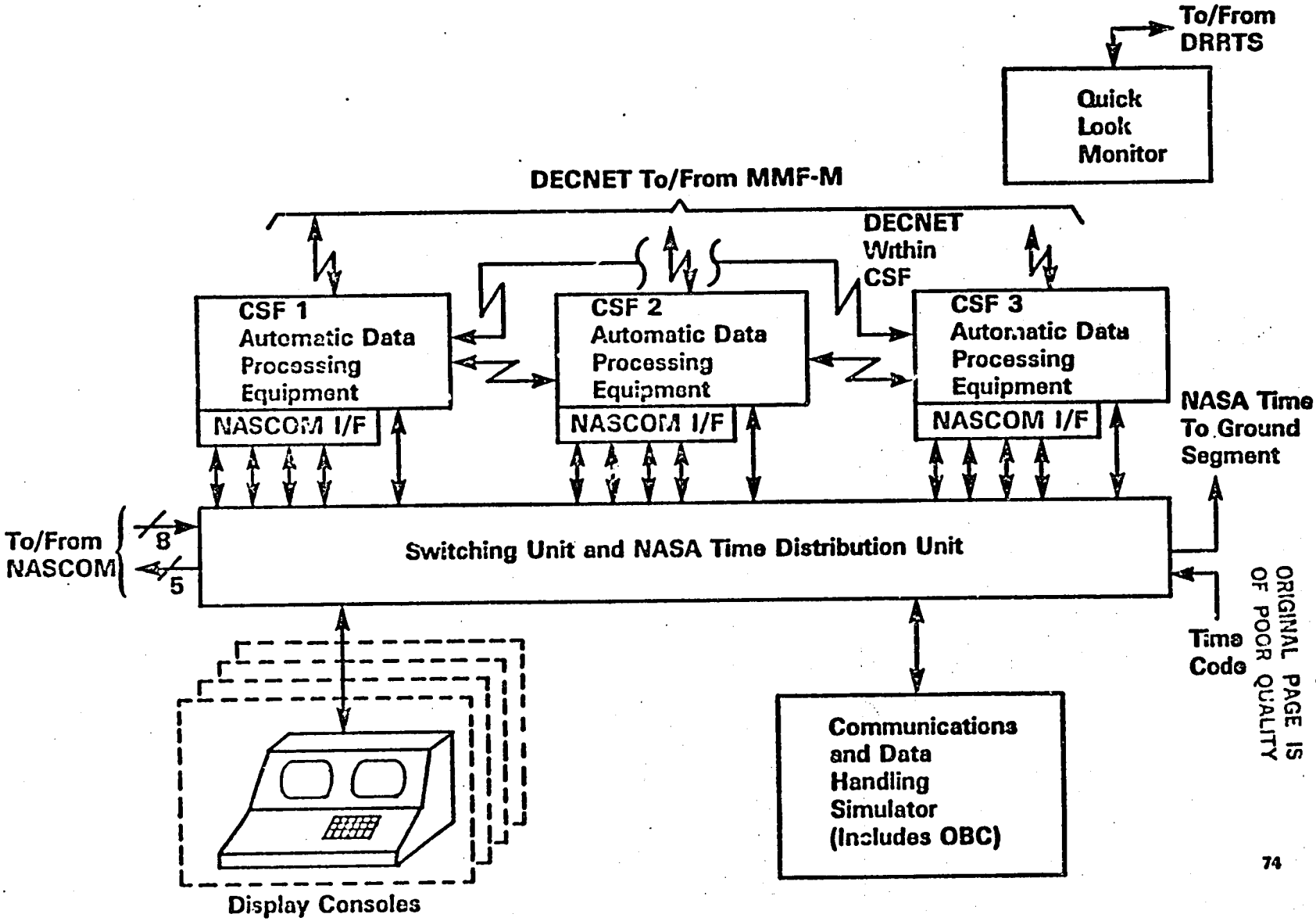


CSF CONTROL ROOM

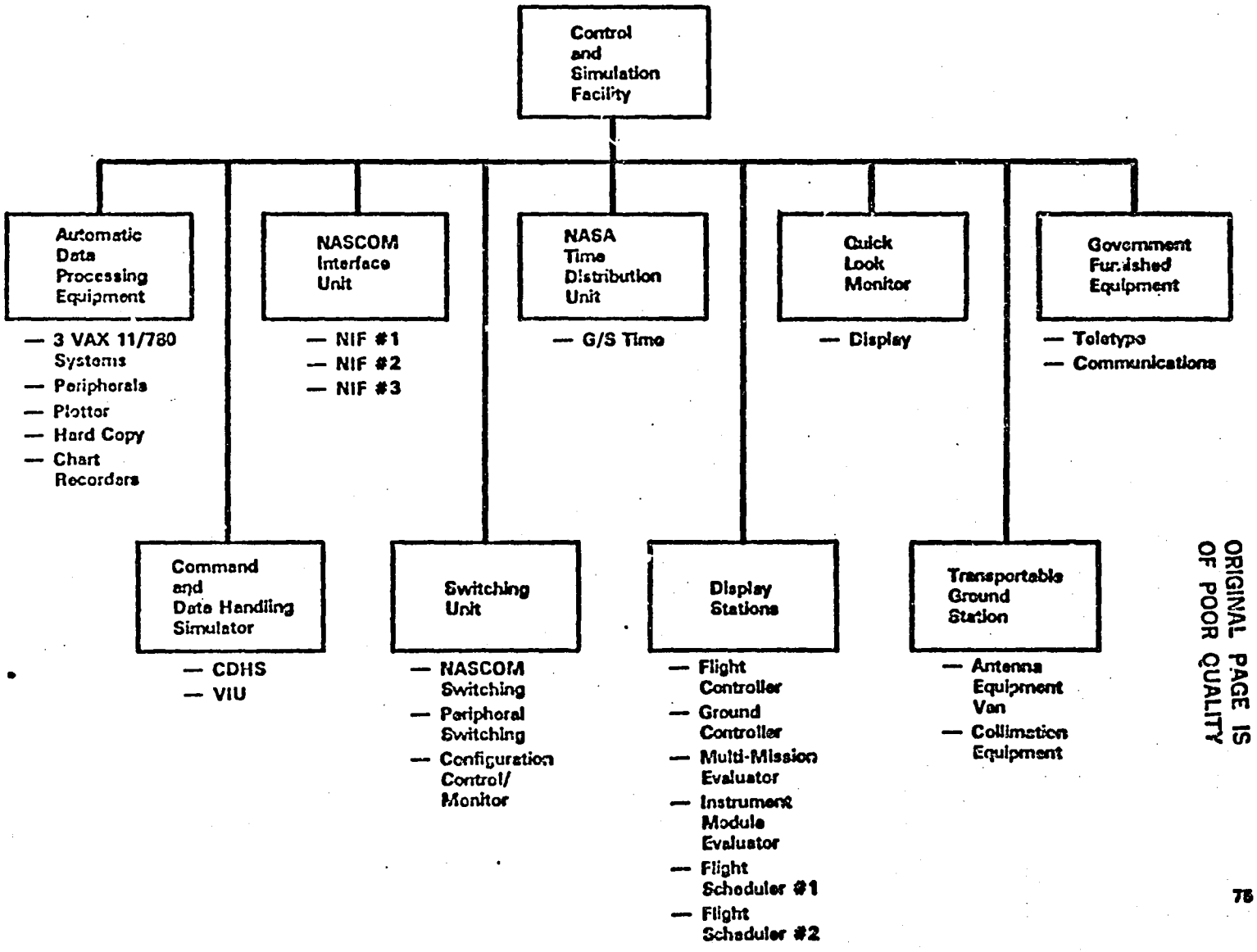


Hardware

CSF Hardware Overview

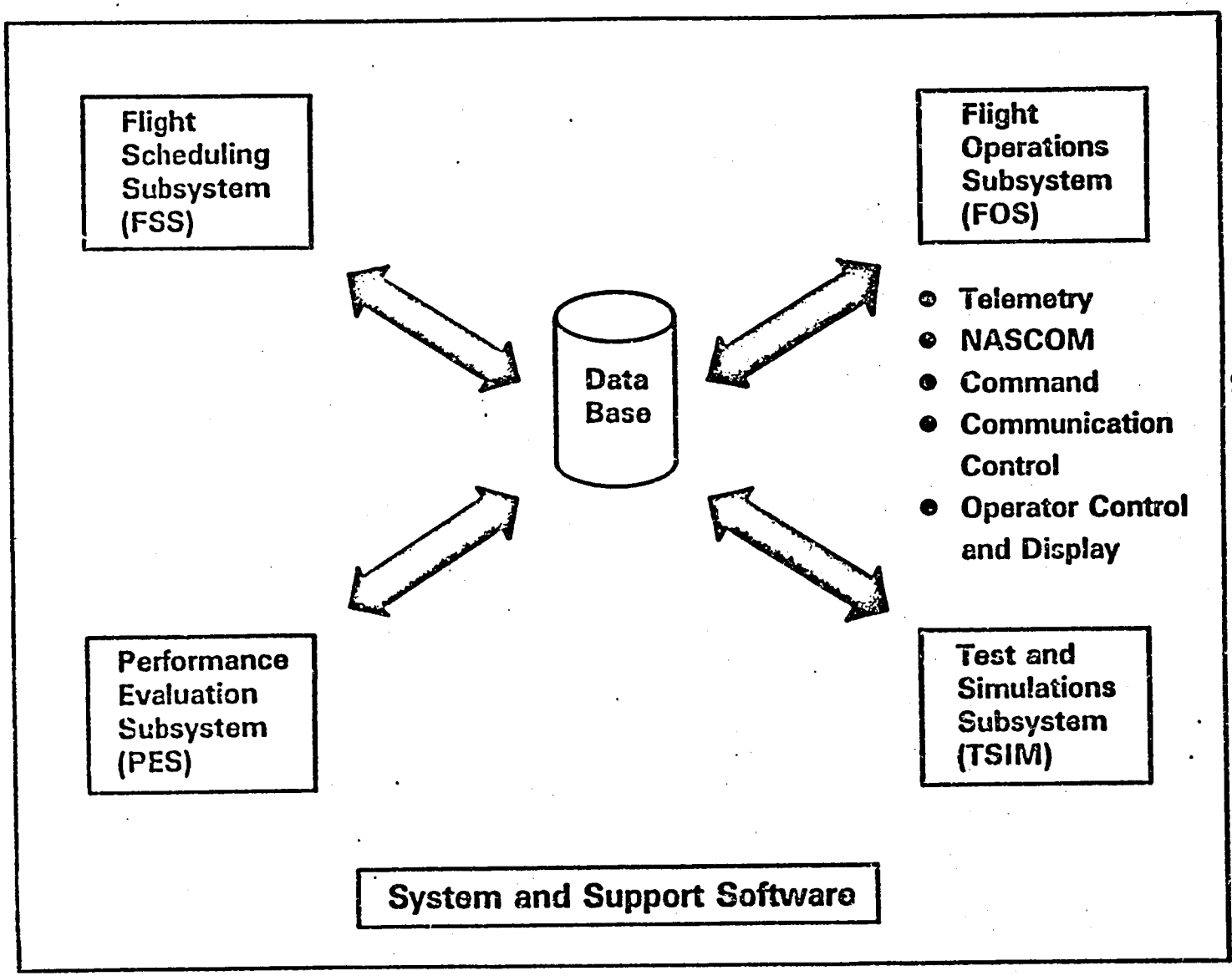


CSF Hardware Structure

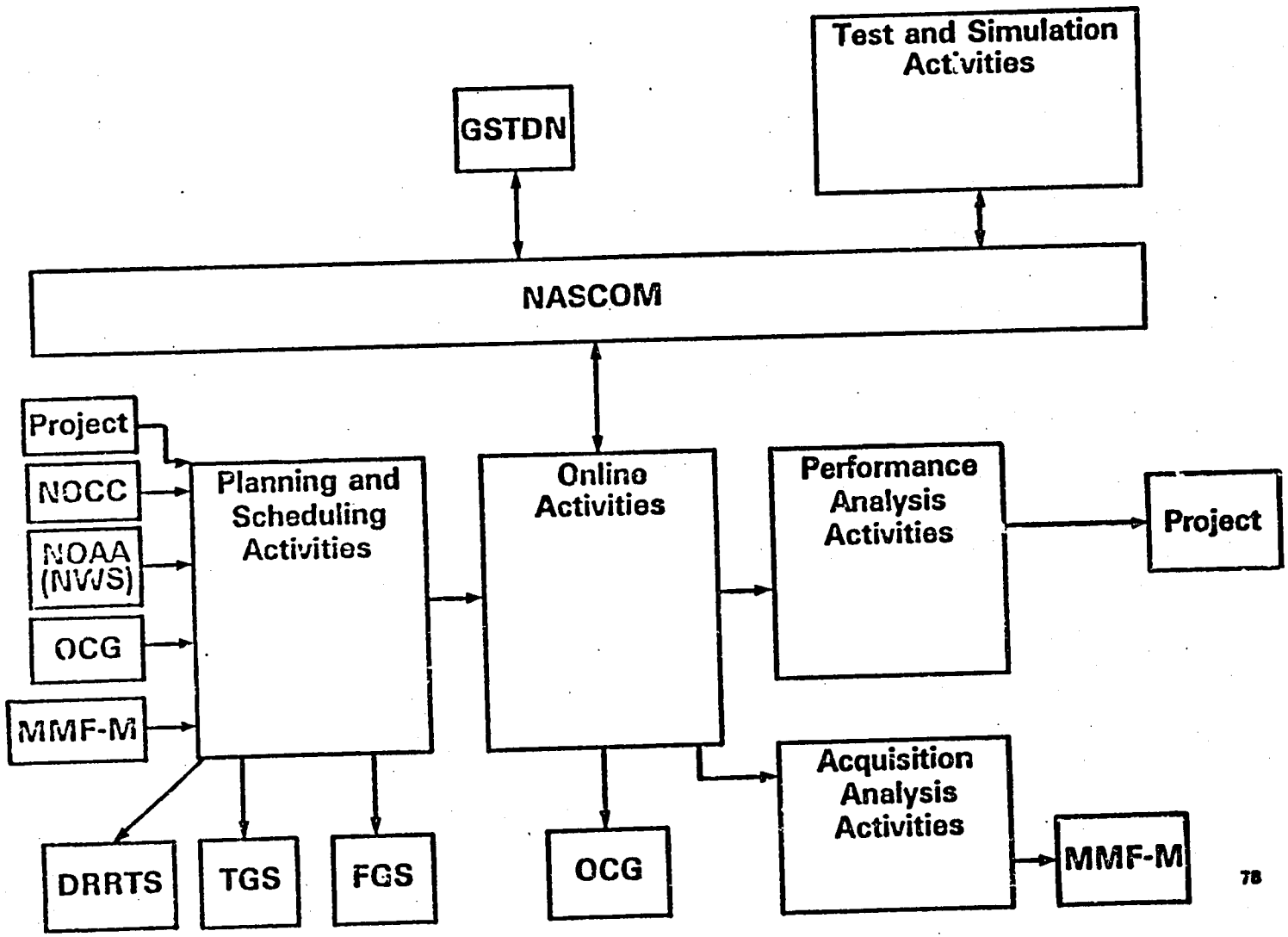


Software

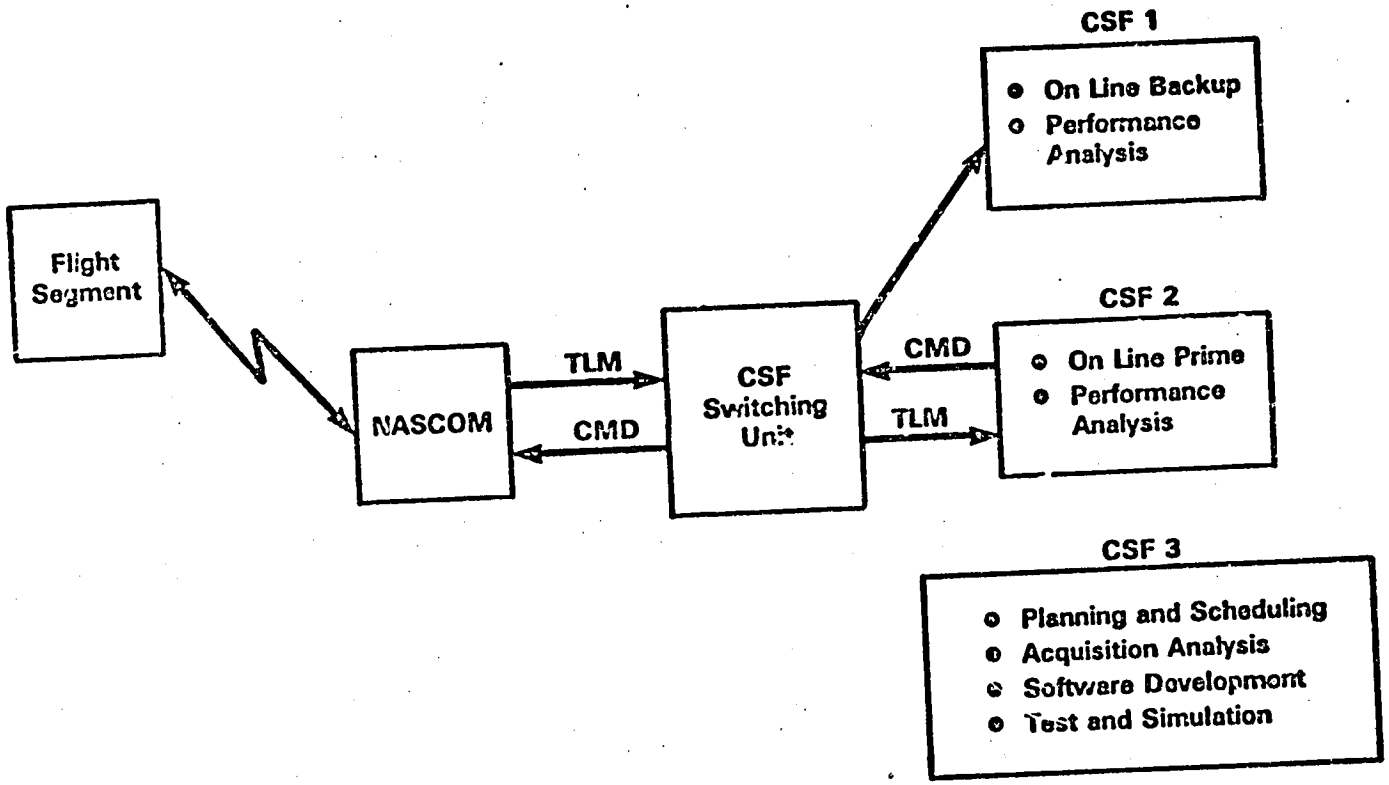
Software Overview



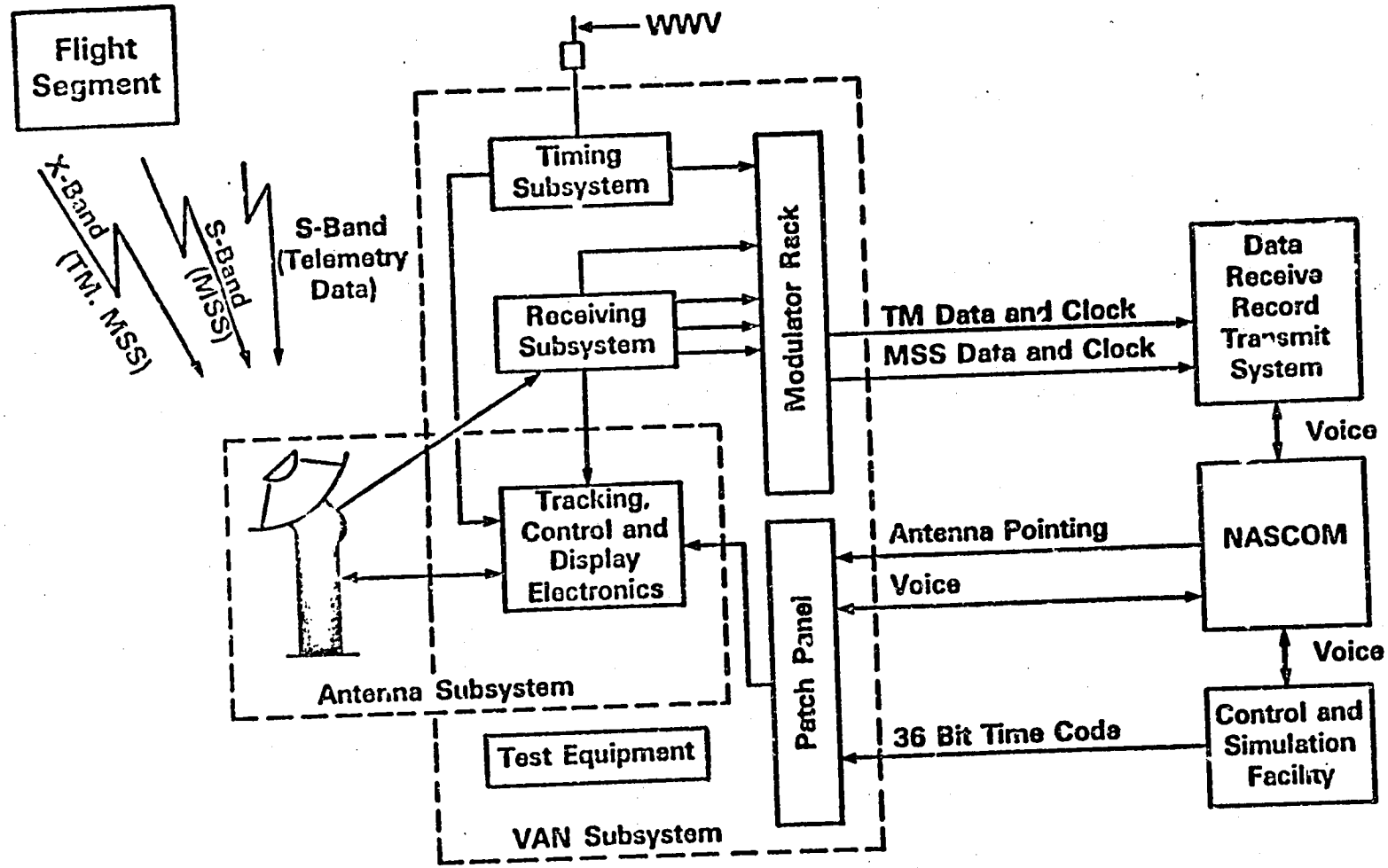
Control and Simulation Facility
Operational Activities Overview



Operational System Configuration



TRANSPORTABLE GROUND STATION
FUNCTIONAL OVERVIEW



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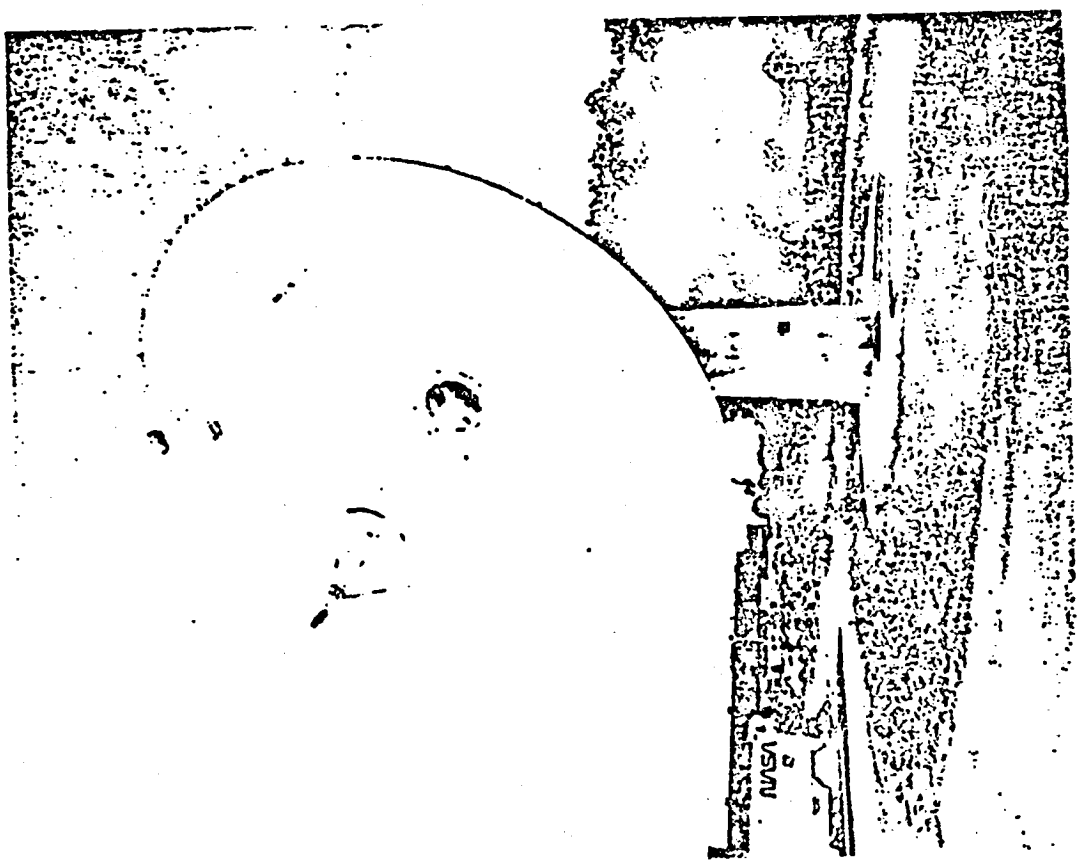
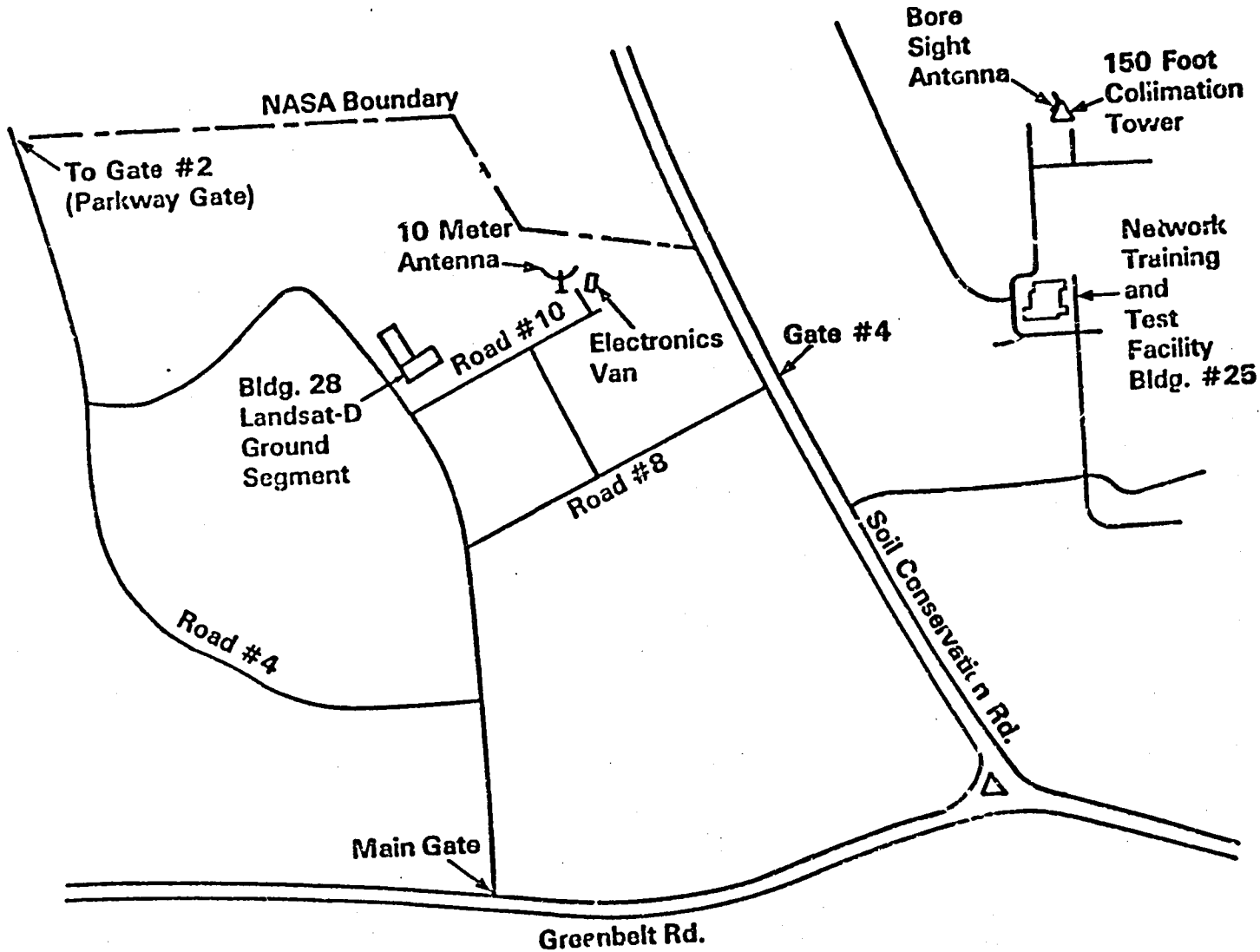
TRANSPORTABLE GROUND STATION



Transportable Ground Station Location



Network Overview

- Requirements
- Tracking & Data Relay Satellite System (TDRSS)
- Ground Station Tracking Data Network (GSTDN)
- Nascom
- Special Support
- Orbit Support Computing Facility (OSCF)

Requirements

Telemetry:

- Provide Support of Housekeeping Telemetry — TDRSS and GSTDN
- Provide Support of Multispectral Scanner Image Data — GSTDN
- Provide Support of MSS and Thematic Mapper (TM) Image Data — TDRSS

Command:

- Provide Support of Commands to Flight Segment — TDRSS and GSTDN

Tracking:

- Provide Raw Tracking Data from GSTDN and TDRSS for Orbit Determination Support to Project

Requirements (Continued)

Communications:

- Provide Narrowband and Wideband Communications to Support Housekeeping Telemetry, Command and Tracking Functions
- Provide Wideband Communications for Image Data Transfer (Both Raw and Processed)
- Provide for Teletype Interfaces with Foreign Ground Stations

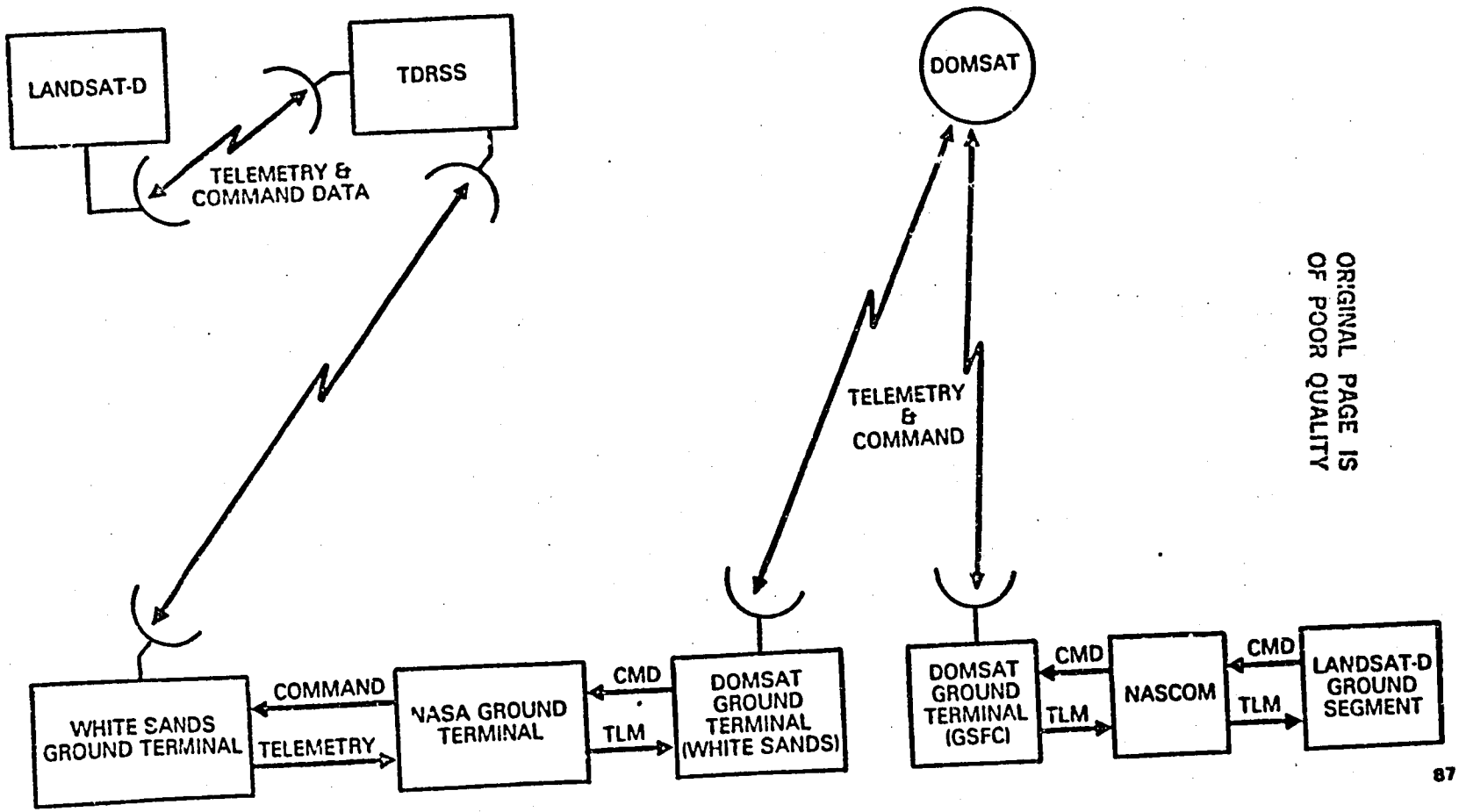
Other:

- Coordinate Western Test Range (WTR) and Indian Ocean Site (IOS) Launch Support — Including Data Acquisition and Transfer

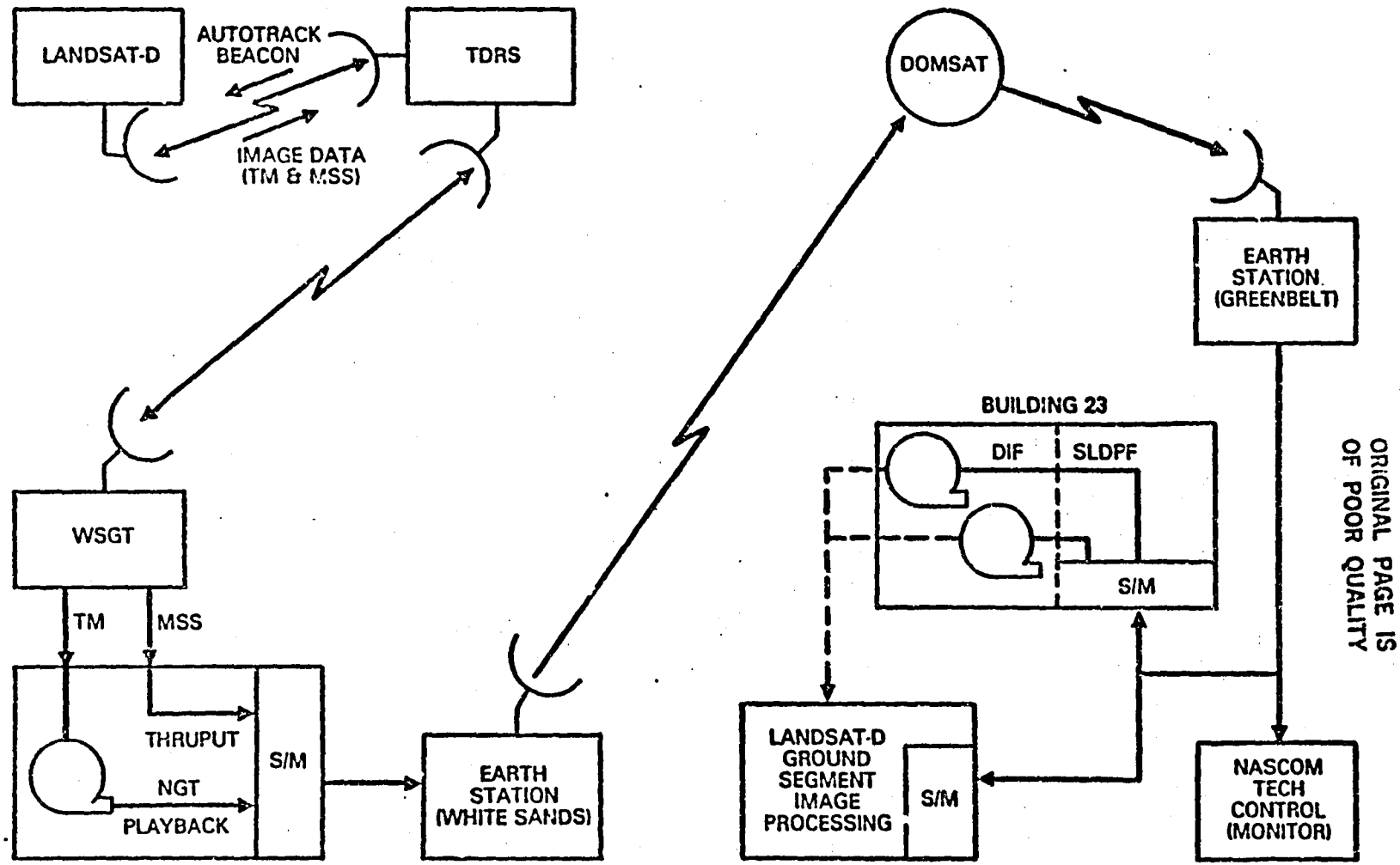
TDRSS

- Command and Telemetry Data Flow
- Image Data Flow

TDRSS Command and Telemetry Data Flow



TDRSS Image Data Flow



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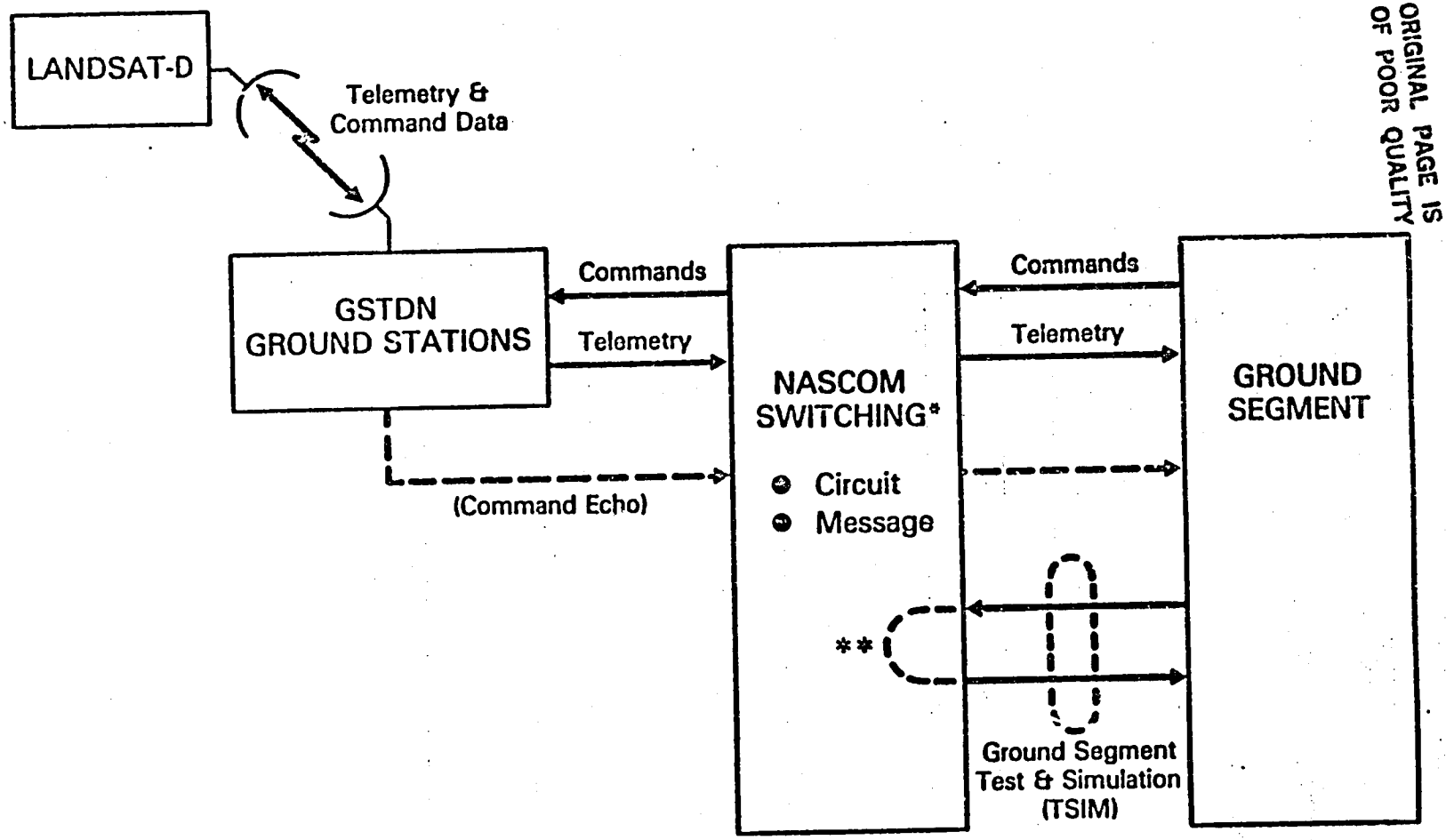
GSTDN

- Command and Telemetry Data Flow
- Multispectral Scanner (MSS) Image Data Flow
- Station Support Functions
- Status

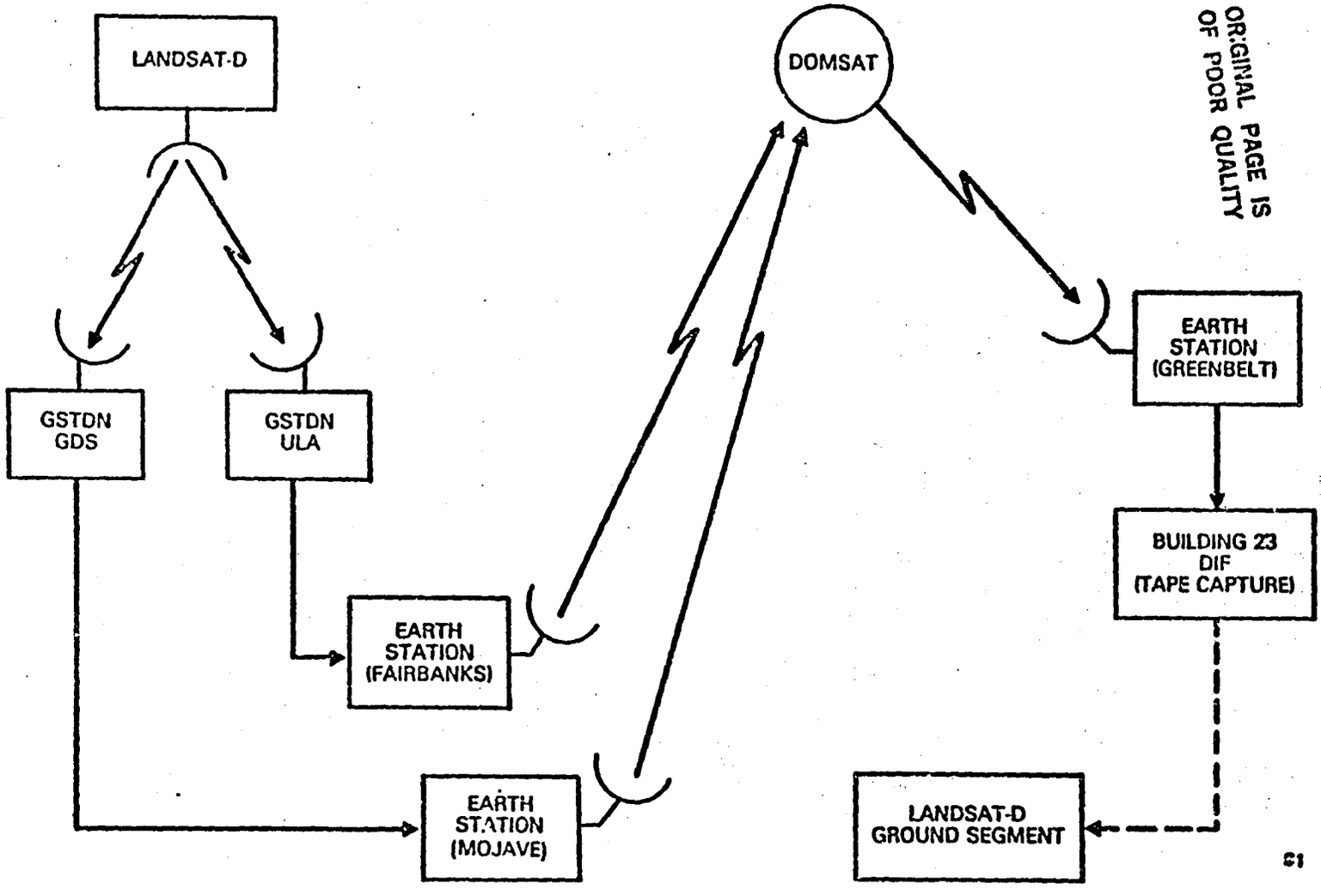
GSTDN Command and Telemetry Data Flow



*Nascom Switching includes both circuit switching and message switching as applicable to the scheduled transmission path

**TSIM Loop-Back through Nascom Switching

GSTDN MSS Image Data Flow



GSTDN Station Support Functions

SPACECRAFT ORBITAL OPERATIONS

	ACN	AGO	BDA	BLT	GDS	GWM	HAW	MAD	MIL	ORR	ULA
8 Kbps Housekeeping	x	x	x	x	x	x	x	x	x	x	x
32 Kbps Payload Correction Data				x							
32 Kbps On Board Computer	x	x	x	x	x	x	x	x	x	x	x
256 Kbps STR Dump	x	x	x	x	x	x	x	x	x	x	x
2 Kbps Command	x	x	x	x	x	x	x	x	x	x	x
Range & Doppler Tracking	x	x	x	x	x	x	x	x	x	x	x
Image Data					x						x

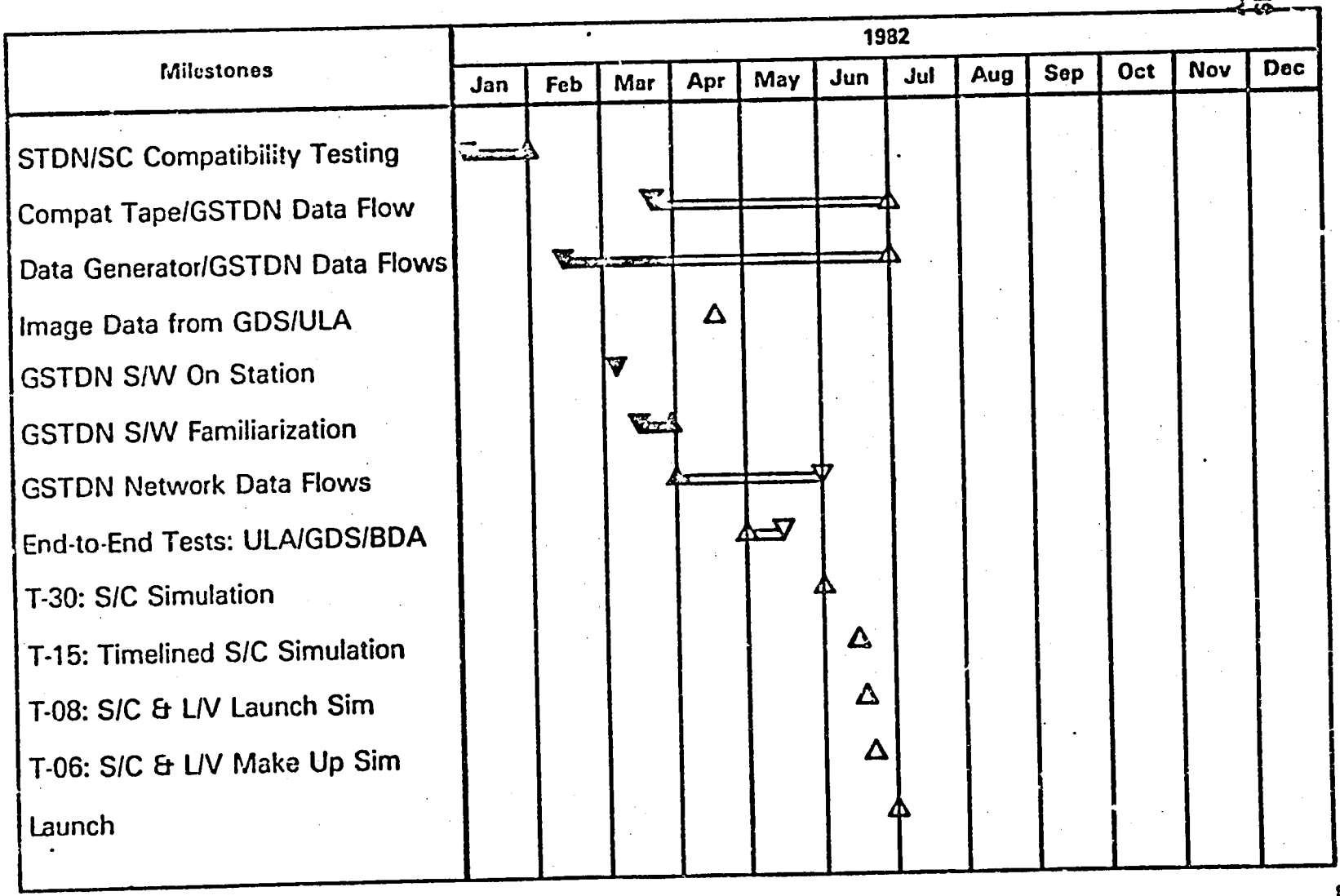
GSTDN Station Support Functions

SPACECRAFT LAUNCH/EARLY ORBIT (48 HOURS)

	ACN	AGO	BDA	BLT	GDS	GWM	HAW	MAD	MIL	ORR	ULA	WTR*	IOS*
S-Band Command	x	x	x	x	x	x	x	x	x	x	x		
S-Band Telemetry	x	x	x	x	x	x	x	x	x	x	x	x	x
S-Band Tracking	x	x	x	x	x	x	x	x	x	x	x	x	

*Special Support

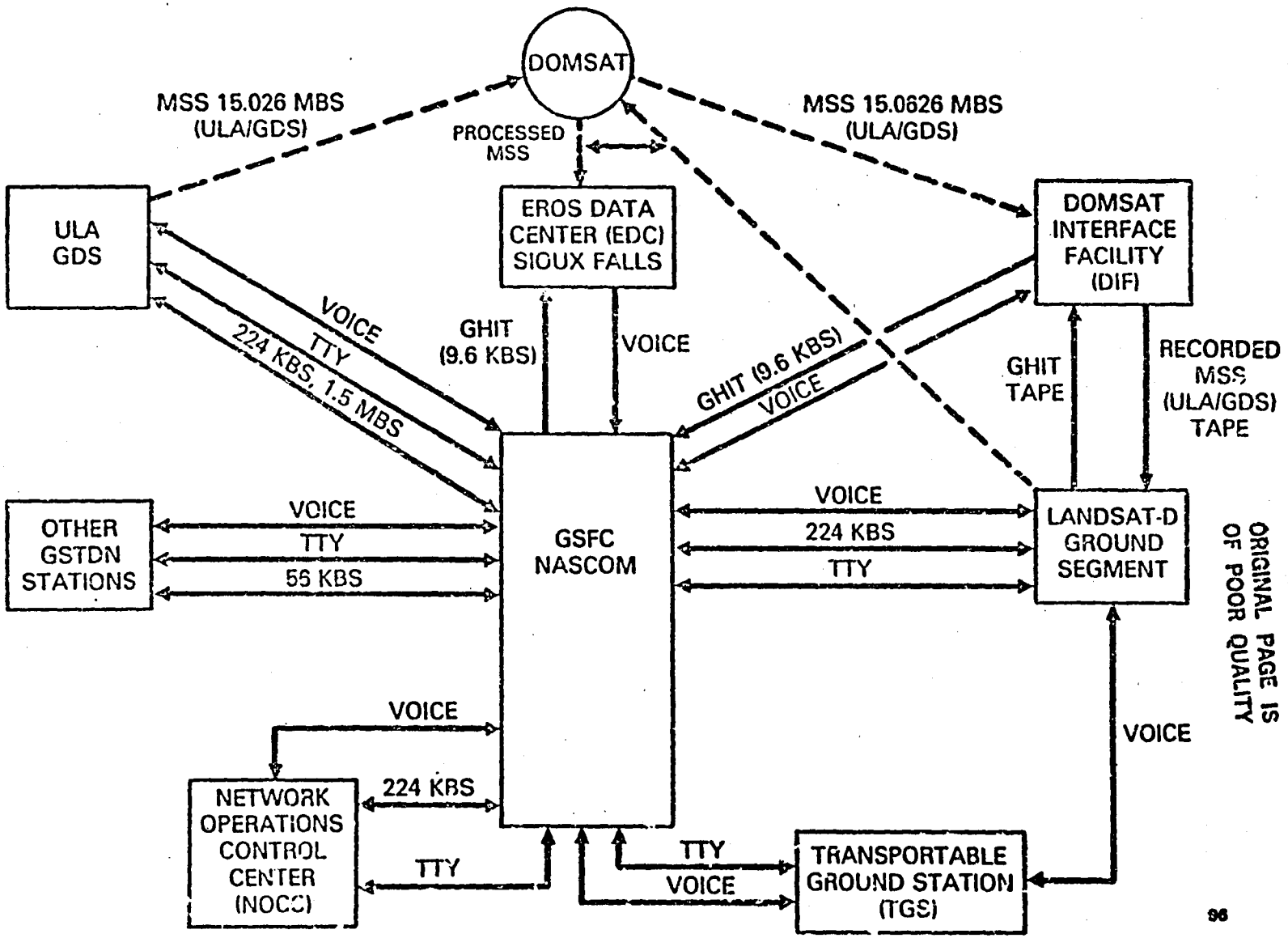
GSTDN/Landsat-D Test and Status



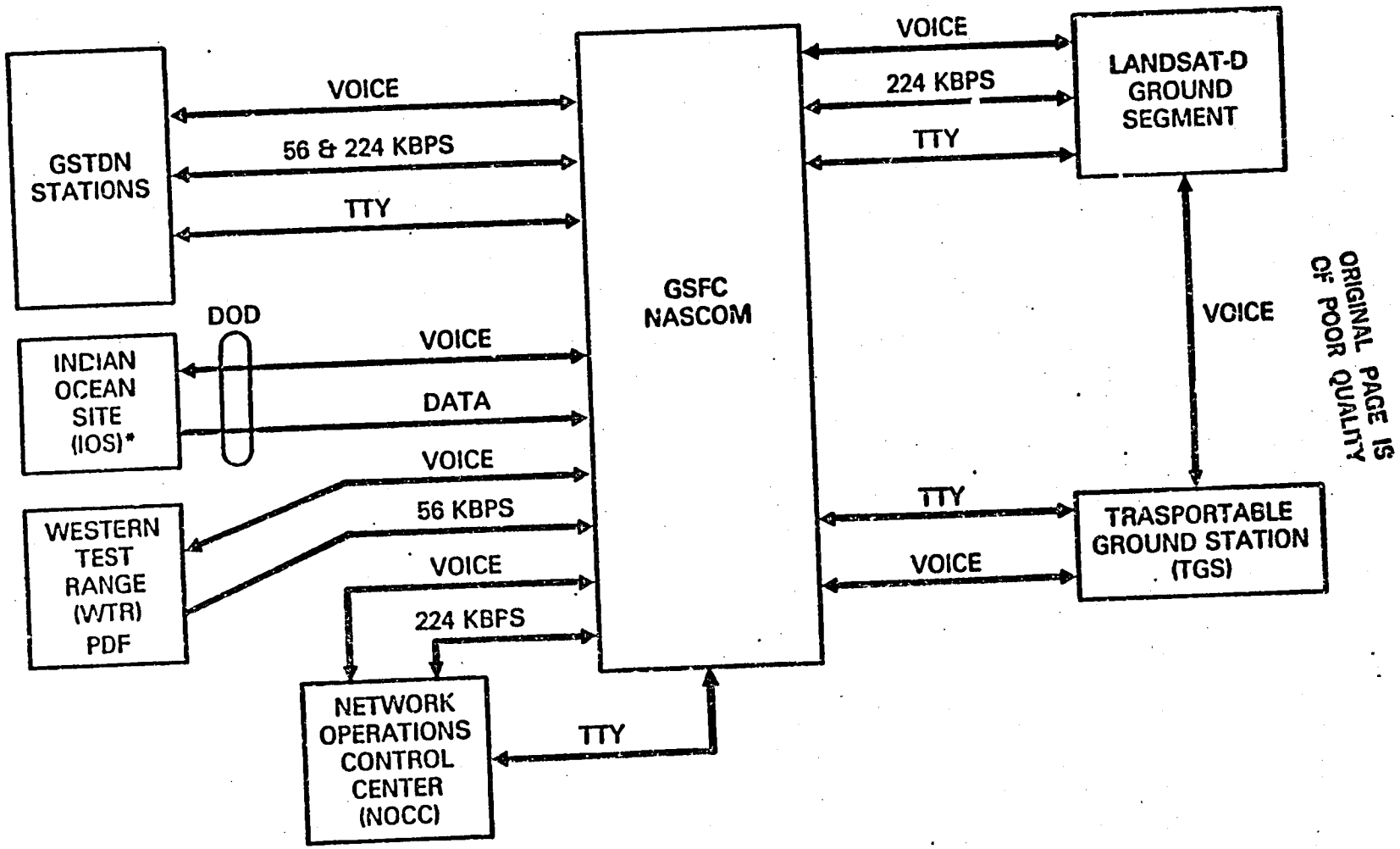
Nascom

- Normal Operations Support
- Launch Support
- Status

NASCOM Normal Operations Support



Nascom Launch Support



*IOS data controlled by Air Force Satellite Command Facility (AFSCF) and routed via BLT to Nascom

C-2

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NASCOM Capability Status

Existing and In-Place:

Housekeeping	9.6 Kb	(All)
Data Circuits	56 Kb	(All)
	224 Kb	(MiL, GDS, BLT) + (BUC for L/V Relay)
	1.5 Mb	(ULA)
Image Data Circuits	15 Mb	(GDS, ULA, DIF, EDC)
	Domsat Link	(Ground Segment/EDC-April 15)

In-Place 8 June, 1982:

Launch Phase S/C Housekeeping Data Circuit	56 Kb (Simplex)	WTR ⟶ GSFC

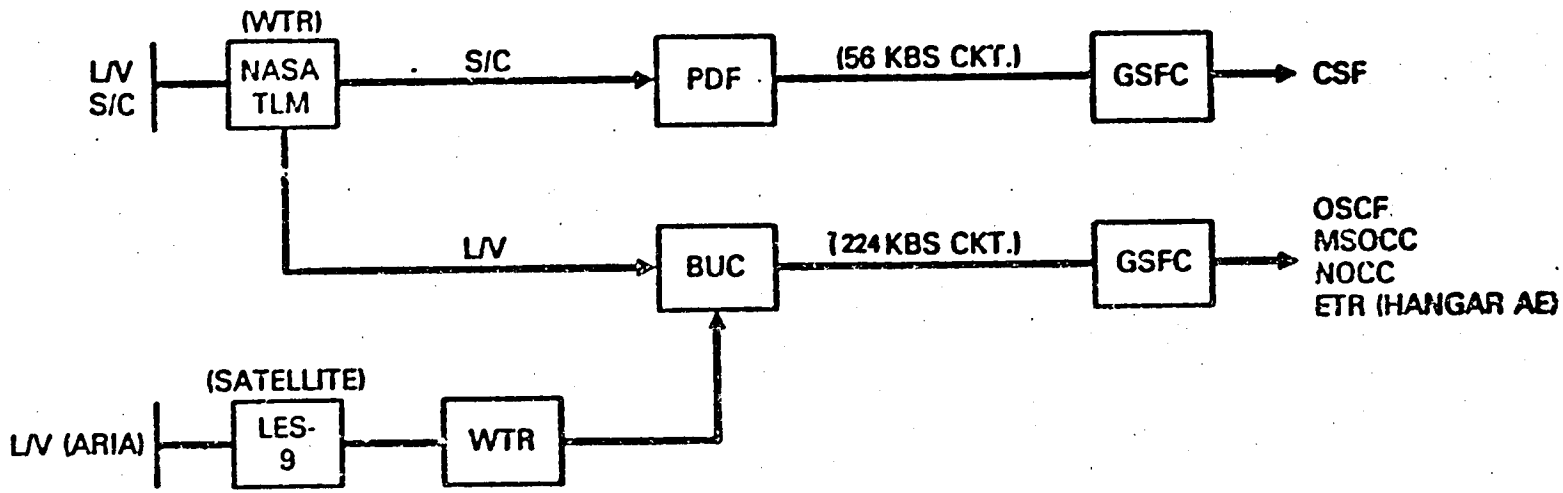
Special Support

- Foreign Ground Stations (FGS)
- Western Test Range (WTR) & Indian Ocean Site (IOS)

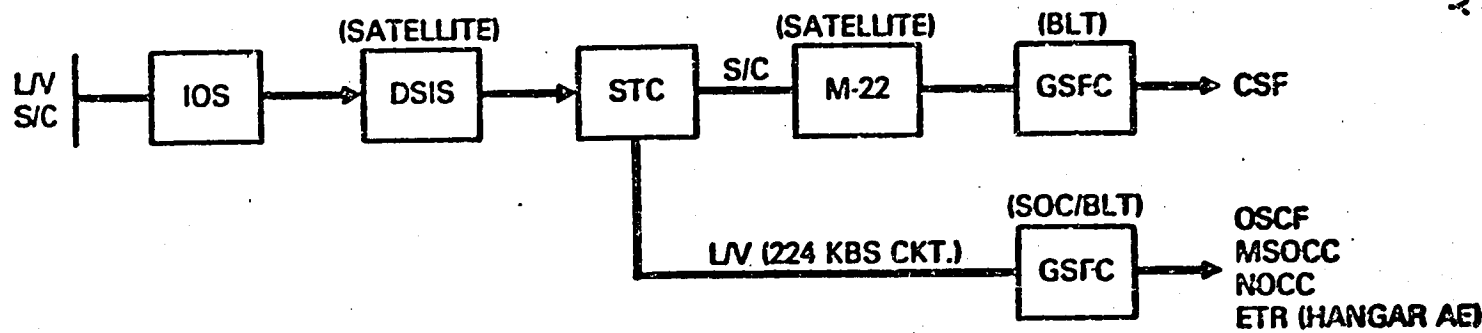
Foreign Ground Station Support

GROUND STATIONS	SUPPORT
Italy Sweden Australia Japan Brazil Canada • Prince Albert • Shoe Cove India Argentina South Africa Thailand	• Provide via teletype acquisition data messages (vectors) for MSS data acquisition
Sweden Australia Japan Brazil	• Provide high density tape stock • Receive via mail MSS tapes recorded at Foreign Ground Stations

Western Test Range (WTR) Support



Indian Ocean Site (IOS) Support



Orbit Support Computing Facility (OSCF)

- Requirements
- Activities
- Data Flow
- Status

Requirements

OSCF

- Provide:
  - Flight Segment Pass Prediction Tape — Weekly
  - Improved Inter-Range Vector (I^2RV) Acquisition Data — Pre-Launch & As Required
  - Predicted Fit Ephemeris Tape (PFET) — Weekly
  - On Board Computer (OBC) Parameters Tape — Daily
  - Orbital Elements — Daily
  - Hardcopy Printouts of TDRSS Operations Planning and Scheduling Aids System (TOPSAS) — Weekly & As Required
- Monitor Downlinked Ephemeris Data as Computed by the On Board Computer

PROJECT

- Provide:
  - On Board Computer Parameters
  - Global Positioning System Data

Activities

Pre-Launch

- Provide Nominal Improved Inter-Range Vector (I^2RV) Acquisition Data
- Provide Nominal On-Board Computer (OBC) Parameters
- Provide Other Data Products as Required by the Project

Launch (Using Goddard Real-Time System-GRTS):

- Determine Launch Vehicle Orbit Based on Guidance Data Received from the Network
- Process Landsat-D Spacecraft Tracking Data in Real-Time
- Update I^2RV Data, OBC Parameters and All Other Required Nominal Pre-Launch Products

Activities (Continued)

Post-Launch (Normal Operations):

- Ingest Tracking Data from GSTDN and/or TDRSS
- Ingest GPS Strip Tape from Landsat-D CSF
- Produce:

  14 Day Flight Segment Pass Prediction Tape (Produced Weekly, Defines Visibility to Foreign Ground Stations, TDRS, GSTDN and Transportable Ground Station (TGS))

  Hardcopy Printouts (3) of TOPSAS (Contains STDN Pass Predictions, Orbital Plots, Pass Summary Predictions and Ground Trace Predictions for the Same 14 Day Period as Pass Prediction Tape Above — Produced Weekly)

  Improved Inter-Range Vector (I^2RV) Prediction Data for TGS, Foreign Ground Stations and STDN (Produced Daily)

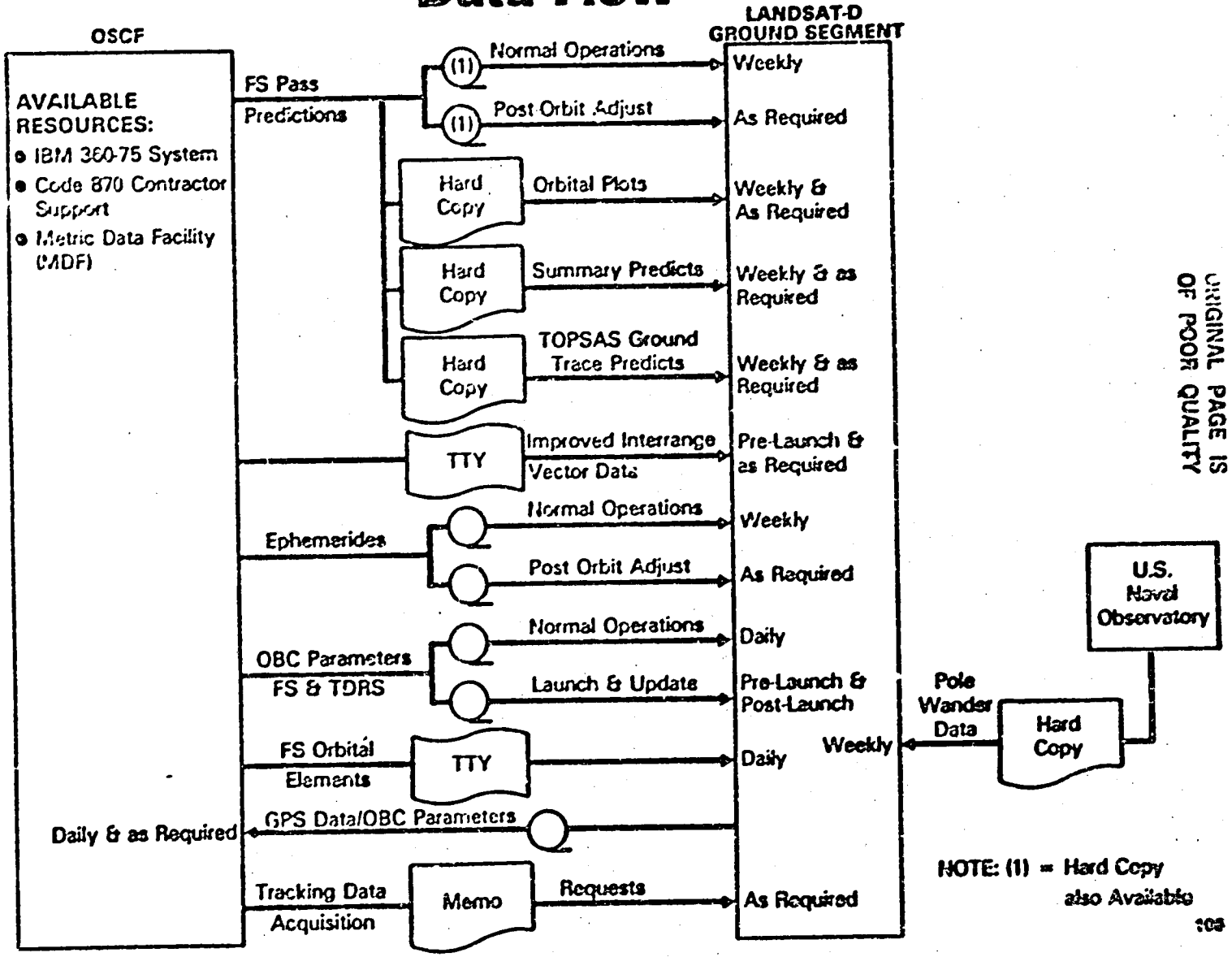
  Predicted Fit Ephemeris Tape Covering Same 14 Day Period as Pass Prediction Tape (Produced Weekly)

  On Board Computer Parameters Tape (Covers a 60 Hour Period — Produced Daily)

  Orbital Elements (Produced Daily and Distributed by Teletype)

- Compare the OBC Computer Orbits of Landsat-D, TDRS-E and TDRS-W (After They Become Operational) with the Ground Produced Orbits

Data Flow



Status

- All Software and Procedures are Tested and Ready

Mission Support Computing and Analysis Division (MSCAD)

- Mission Analysis Support
- Global Positioning System (GPS) Support

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Mission Analysis Support

- Requirements
- Activities
- Information Flow
- Status

Requirements

MISSION ANALYSIS SUPPORT

- Provide Orbit Adjust Definition:
  - Primary/Backup Orbit Adjust Mode
  - Flight Segment Yaw and Pitch Angles
  - Orbit Adjust Start Time
  - Orbit Adjust Thruster Impulse Count
  - Predicted Thrust Level
  - Predicted Tank Pressure and Temperature Change
  - Predicted Propellant Usage
- Provide Orbit Adjust Burn Analysis:
  - Orbital Element Changes
  - Orbit Adjust Thruster Efficiency
  - Propellant Expended

PROJECT

- Provide:
  - Orbit Adjust Criteria Document
  - Orbit Adjust Propulsion Module Status
  - Orbit Adjust Burn Confirmation

Activities

Pre-Launch:

- Orbital Element Studies
- Orbit Selection
- Launch Window
- Propulsion System Modeling
- Orbit Maneuver Strategies

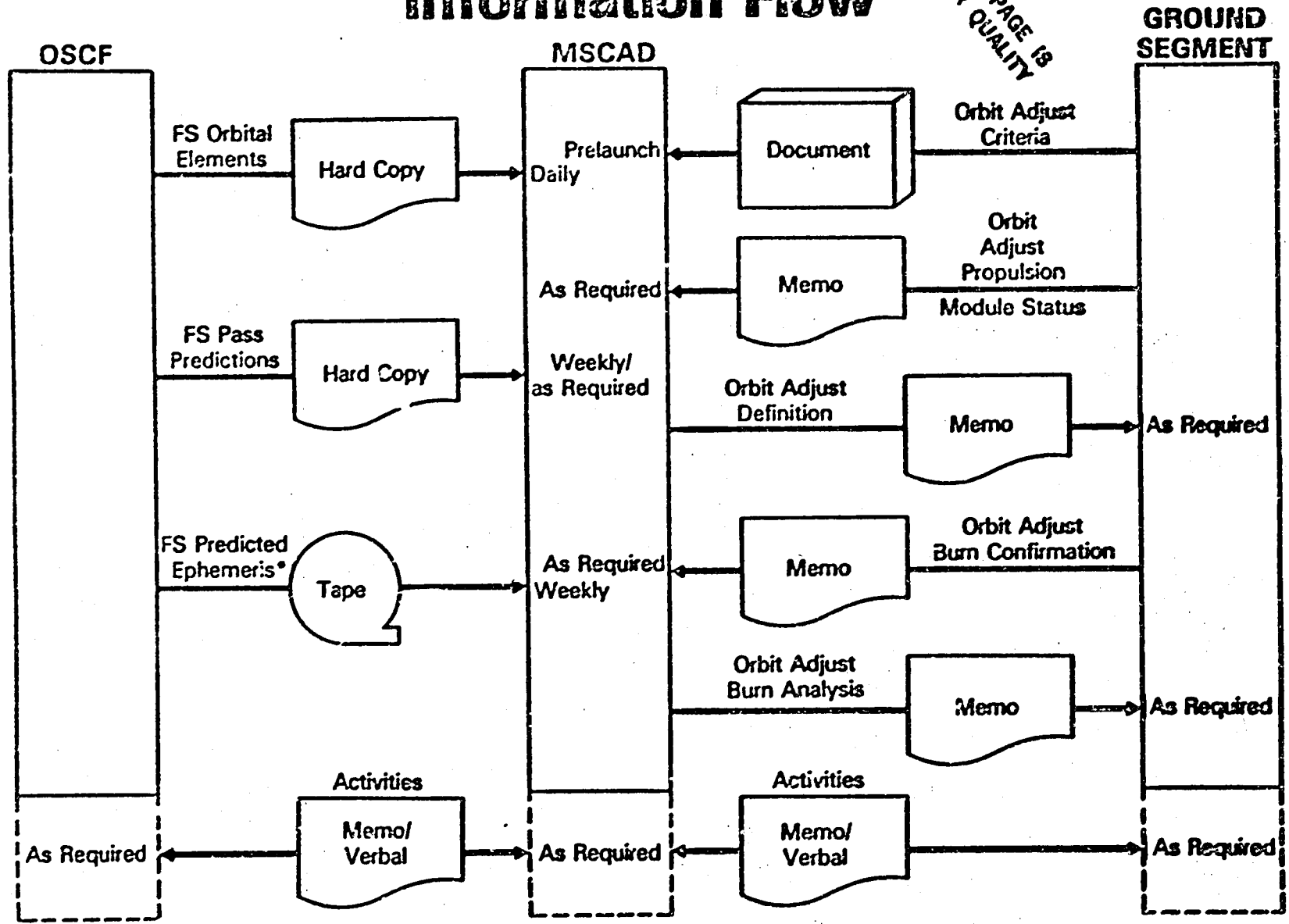
Launch:

- Injection Error Removal Maneuvers
- Ground Track Phasing Maneuvers
- Contingency Maneuvers

Post-Launch:

- Orbital Mission Requirements
- Orbital Maintenance Maneuvers
- Propulsion System Modeling Calibration
- Shuttle Retrieval Maneuvers

Information Flow



Status

- Orbit Adjust Software Ready
- No Present or Foreseen Problems

Global Positioning System (GPS) Support

- Requirements
- Functions
- Data Requirements
- Data Flow
- Validation and Calibration Procedures
- Status

Requirements

GLOBAL POSITIONING SYSTEM (GPS)

- Validation —

  Routinely Monitor and Verify That GPSPAC Orbit Solution on Landsat-D is Reliable and Accurate to 50 Meters When 4 NDSs are in View and to 150 Meters in Trajectory Propagate Mode

- Calibration —

  Determine Ultimate Accuracy with Which the GPS Can Provide Real-Time, Onboard Estimates of Orbit and Time

PROJECT

- Provide GPS Data and On-Board Computer Parameters

Functions

- Compare Onboard GSPAC Estimates and Statistics of Landsat-D State with Those Derived from Independent Sources
- Perform Navigation Reconstruction Using a Variety of Models
- Analyze and Change Various Constants of the Onboard Data Base to Improve Navigation Performance
- Determine Those Factors Which Limit the Ultimate Accuracy Achieved by the System

Data Requirements

GPS Strip Tape

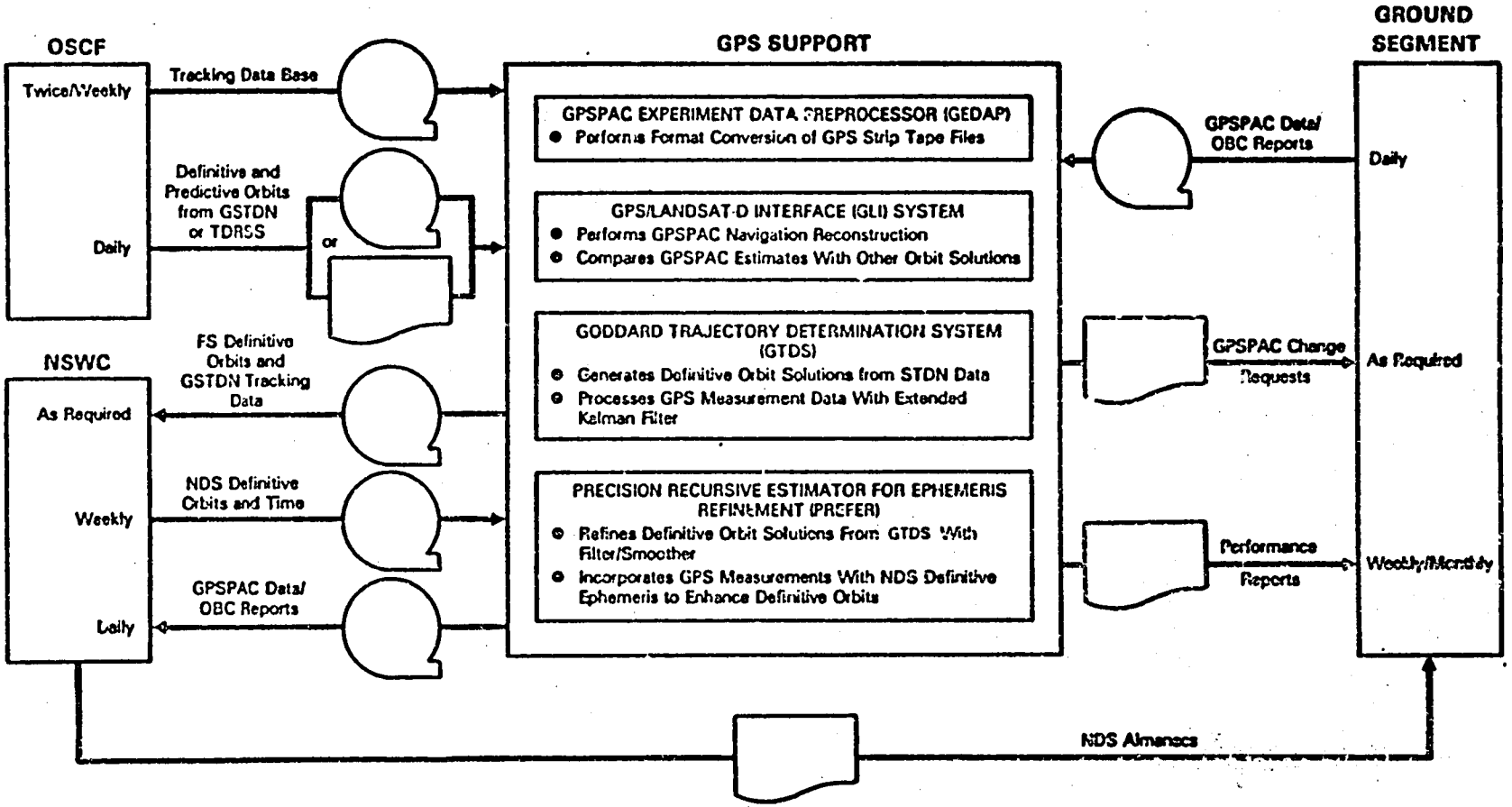
- GPSPAC Output Data Files
  - System Status
  - NDS Almanacs and Operating Ephemeris
  - Navigation Estimates
  - GPS Measurements
  - Receiver Diagnostics
- OBC Ephemeris Computation Reports
  - Uplinked Ephemeris
  - GPSPAC Derived Ephemeris

Definitive and Predictive Orbits Derived from GSTDN or TDRSS Tracking Data

GSTDN Tracking Data

NDS Definitive Orbits and Time

Data Flow



Validation and Calibration Procedures

Validation Phase (7/82 to 10/82)

- Tasks Performed Daily:
  - Extract GPS Strip Tape Files
  - Reconstruct GPSPAC Navigation Solution
  - Compare GPSPAC Estimates with OBC Ephemeris and Reconstructed Solutions
- Tasks Performed Weekly:
  - Compare GPSPAC Estimates with STDN Definitive Orbits
  - Generate Refined Orbit Solutions and Compare with GPSPAC Estimates
  - Report on Results

Calibration Phase (10/82 to 7/83)

- Daily Validation Tasks Will be Performed Twice Per Week
- Tasks Performed Weekly:
  - Compare GPSPAC Estimates with STDN Definitive and Refined Solutions
  - Process GPS Measurement Data and NDS Definitive Ephemeris with GTDS and PREFER
  - Compare Solutions with GPSPAC Estimates and STDN Definitive Orbits
- Report on Results on Monthly Basis

Status

- GPS Support Software Developed
- System Testing to be Completed by April 30th
  - One Sample GPS Strip Tape Processed
  - Will Process Additional Sample GPS Strip Tapes as Received
  - Tests with Simulated GSTDN Tracking Data and NDS Definitive Ephemeris Tapes
- GPS Experiment Readiness Review Scheduled for April 30th
- Landsat-D Ground Segment/OCG (MSCAD) ICD Completed
- OSCF/MSCAD ICD In Review

NOAA National Weather Service (NWS)

- Requirement
- Prediction Process
- Output

NWS Forecast Support Requirement:

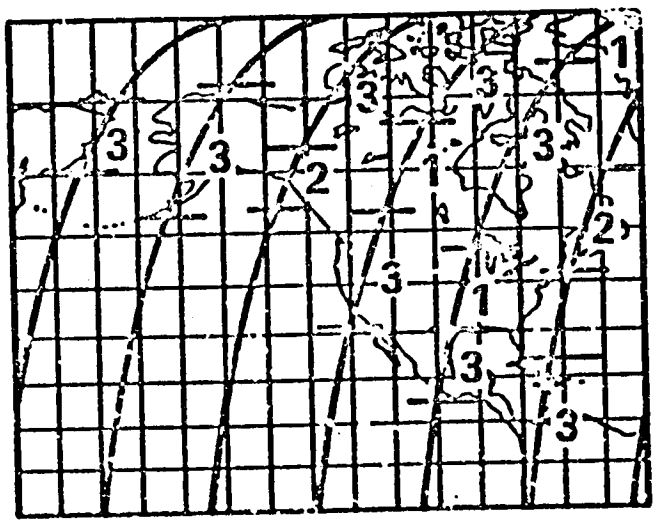
To Provide to the Landsat-D Ground Segment Daily Global Cloud Cover Forecasts Along Satellite Ground Tracks

Prediction Process

Inputs:

- Global and Regional Numerical Guidance Products
- NOAA Polar Orbiting and Four Geostationary Satellite Imagery
- Global Surface Weather Analysis
- Global Cloud Cover Climatic Data

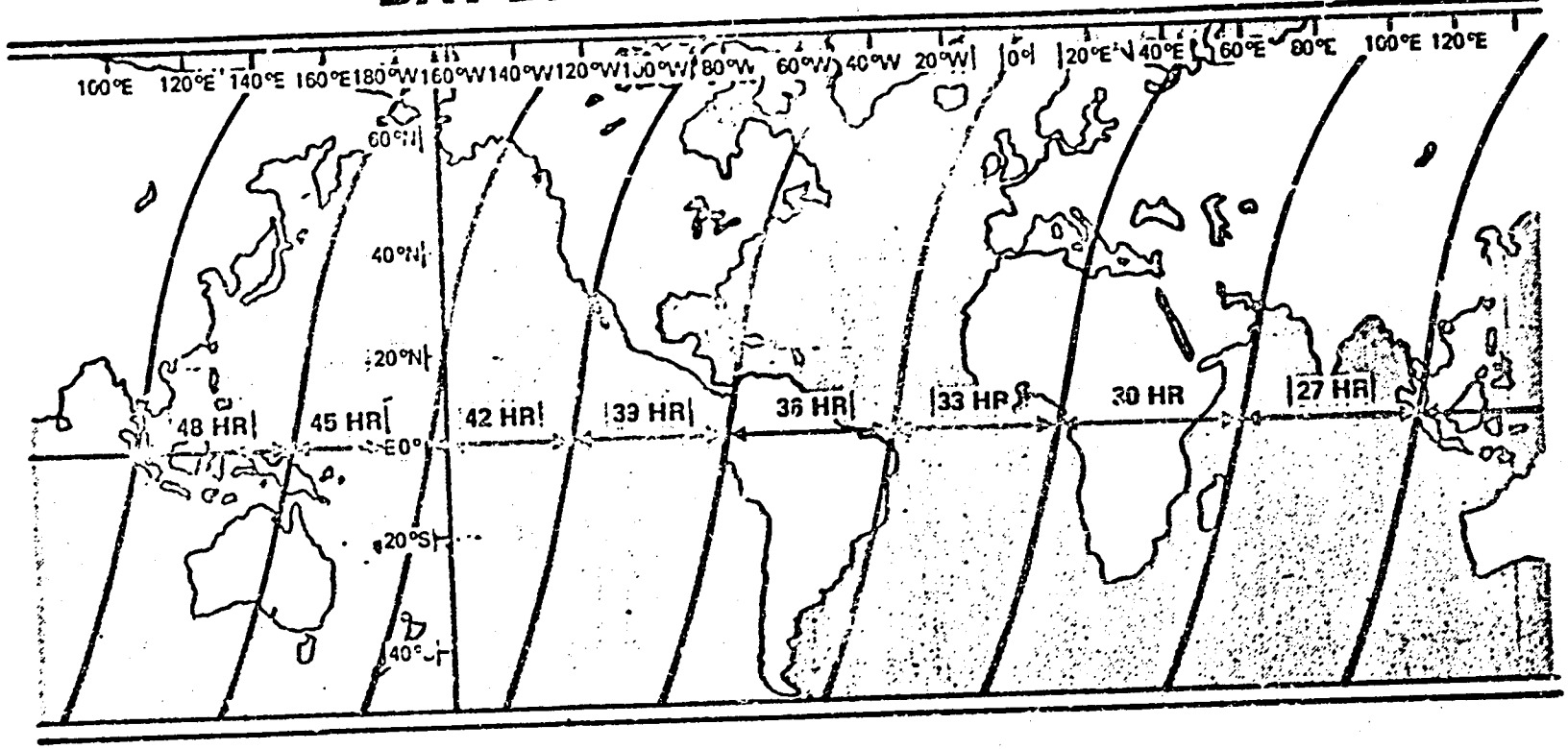
Predict Map:



Cloud Coverage	Code
0 Through 30%	1
31 Through 70%	2
71 Through 100%	3

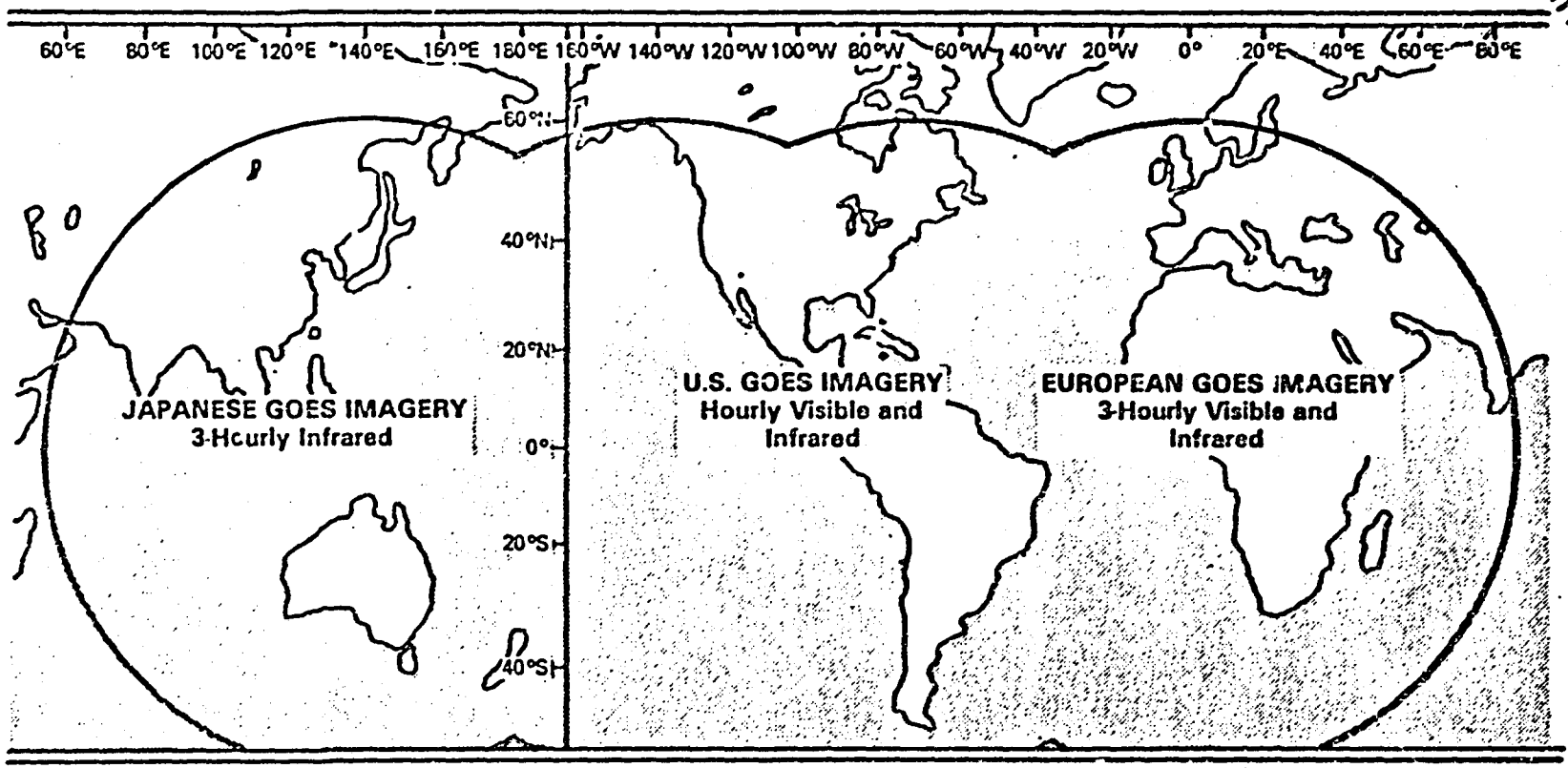
Global Numerical Guidance Input

DAY DESCENDING PACKAGE



27 Hour through 48 Hour 3-hourly increments of surface, 500 mb. and relative humidity values from Sela Global Spectral Model current day 00Z forecast displayed on LANDSAT-D 1/60M map scale provide forecast r expected conditions nearest next day LANDSAT-D local equator crossing times. Similar information supports both descending and ascending forecasts.

Polar Orbiting and Geostationary Satellite Imagery Inputs



NOTE: GOES Areas Also Covered By Polar Orbiter — Pass by Pass Stretched Gridded Visible Imagery, and Mapped Day Visible, Day Infrared and Night Infrared Imagery

Output:

Coded Cloud Cover Predictions for All Land Areas Along Each Next Day Path via Telecopier Link Between the World Weather Building, Camp Springs, MD and the Landsat-D Ground Segment

Landsat-D Cloud Cover Predictions

PATH	ROW START	ROW STOP	CLOUD COVER
13	1	28	3
	29	41	1
	42	87	3
	88	92	2
	~	~	~
	200	248	3
29	1	46	3
	‖	‖	‖

Cloud Coverage	Code
0 Through 30%	1
31 Through 70%	2
71 Through 100%	3

Delta Launch Operations

- Landsat-D Mission Requirements
- Preliminary Flight Mode Description
- Preliminary Sequence of Events
- Trajectory Sequences
- Spacecraft Mission

Landsat-D Mission Requirements

- Osculating Elements at First Descending Node After Spacecraft Separation
  - Semi Major Axis(3σ High) = 7074 km (3819.58 N.MI.)
  - Eccentricity = 0.0001
  - Inclination = 98.255 Deg
- Launch Time Consistent with 0938 Mean Solar Time at Descending Node
  - Approximately 1757 Greenwich Mean Time on July 1, 1982
- Sun Excluded from 30 Deg Half Cone About Centerline of the Thematic Mapper and Multispectral Scanner
- Spacecraft Separation
  - During First Passage Through Umbra
  - At 25.5 Deg South Latitude
  - S/C + X Axis Along Velocity Vector Within 3 Deg Half Cone Angle
  - S/C + Z Axis Toward Earth Center Within 3 Deg Half Cone Angle
- Second Stage Evasive Maneuver
  - ≥1 km (0.54 N.MI.) Away from S/C at Start of Maneuver
  - Maneuver to Lower Semi-Major Axis > 2km (1.08 N.MI.) and Change Inclination
  - 2nd Stage Plume Directed Away from Spacecraft
  - Propellant Depletion Planned to Minimize Orbital Debris (≤ 10 Angstroms)

Preliminary Flight Mode Description

- Launch from SLC-2W at WSMC
- 196 Deg Flight Azimuth
- 6/3 Castor IV Burn Sequence
- Booster Dog Leg Maneuver to Achieve Orbit Inclination
- 101 × 393 n.mi. Transfer Orbit at SECO I
- First Restart (Approx. 16 Sec) Prior to Apogee Establishes Near Circular Orbit (Biased 3 σ Low)
- Vehicle Maneuver to Separation Attitude
- Second Stage Retro at S/C Separation Event (1.5 FPS)
- Second Stage Coast Until at Least 1 km Separation Achieved
- 4 Second Restart Burn to Reduce Semi Major Axis and Change Inclination
- Third Re-Start to Depletion Under Study

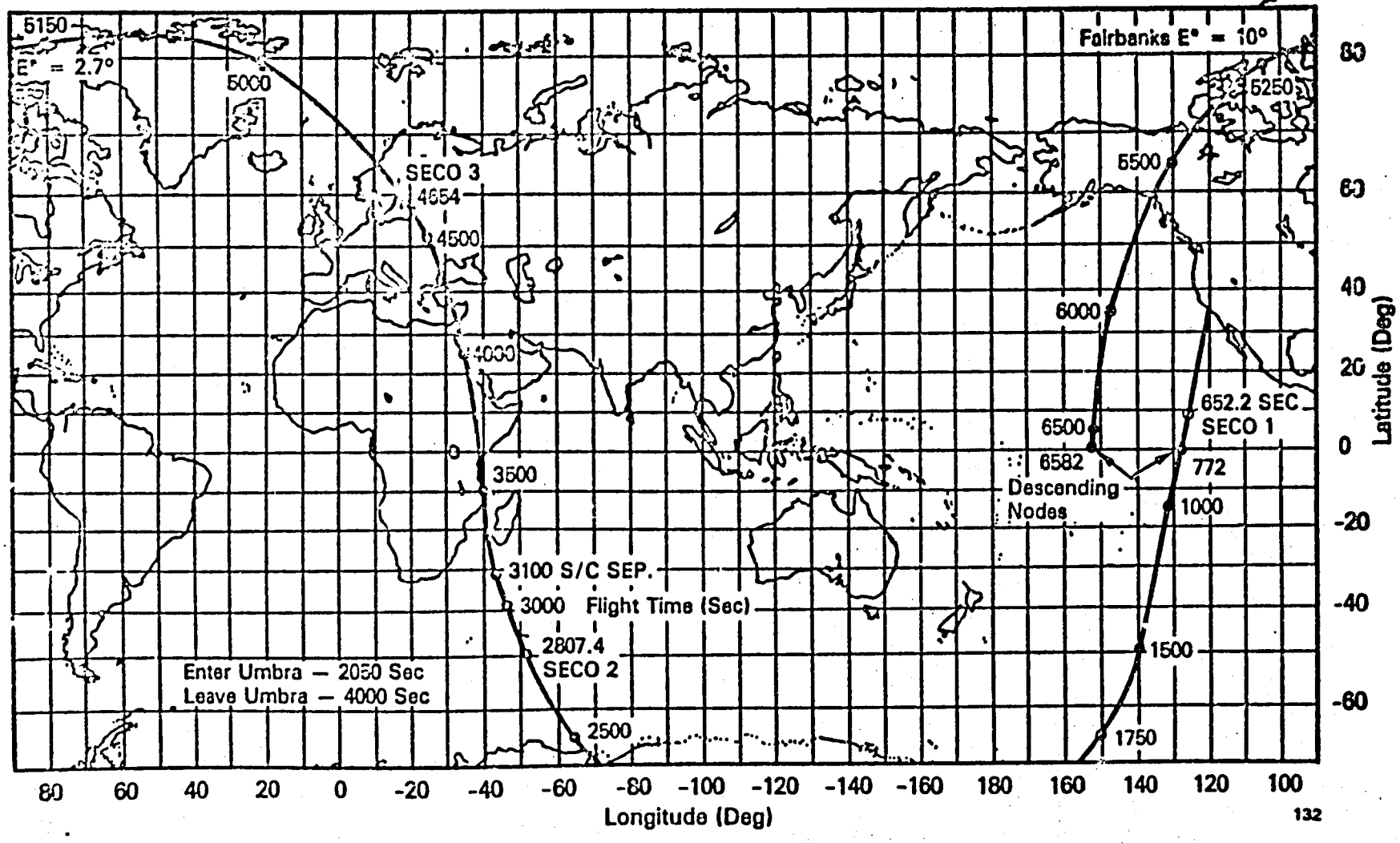
Preliminary Sequence of Events

EVENT	TIME (SEC)
Liftoff	0.0
6 Solid Burnout	57.8
3 Solid Ignition	60.0
Separate 3 Solids	79.0
Separate 3 Solids	80.0
3 Solid Burnout	118.0
Separate 3 Solids	123.5
Main Engine Cutoff (MECO)	226.6
Stage I-II Separation	234.6
Stage II Ignition	239.6
Jettison Fairing	245.0
First Cutoff — Stage II (SECO 1)	652.2
Begin Maneuver to Restart Attitude	700.0
Complete Maneuver to Restart Attitude	955.0

Preliminary Sequence of Events (Continued)

EVENT	TIME (SEC)
First Restart of Stage II	2791.5
Second Cutoff — Stage II (SECO 2)	2807.4
Begin Maneuver to Landsat-D Separation Attitude	2850.0
Complete Maneuver to Landsat-D Separation Attitude	3040.0
Landsat-D Separation, Activate Retro System	3100.0
Begin Maneuver to Restart Attitude	4200.0
Complete Maneuver to Restart Attitude	4500.0
Restart Stage II	4650.0
Burnout Stage II	4654.3
Restart Stage II	TBD
Stage II Depletion	TBD

Landsat-D Spacecraft Mission



Flight Segment Operations

- Flight Operations Documentation
- Major On-Board Functions
- Activation
- Normal Operations
- Contingencies

Flight Operations Documentation

- Landsat-D Data Format Control Books
  - Vol. 1 Data Acquisition Plan
  - Vol. 2 Telemetry
  - Vol. 3 Command
  - Vol. 4 GPS
  - Vol. 5 Payload
- Landsat-D Flight Segment Operations Manual
  - Vol 1 & 2 Subsystems
    - APP. A Coefficients/Calibration Data
    - APP. B OBC Software Operations
- Landsat-D Observatory System Restraints Manual
- Landsat-D FS to TDRSS/GSTDN RF ICD
- Landsat-D FS Flight and Operations Plan for the OCC:
  - Vol. I Flight Operations Plan
  - Vol. II Flight Activation Plan
- Orbit Adjust Criteria
- Flight Segment Evaluation Plan

Major On-Board Functions
Normal

FUNCTION	CHARACTERISTIC
Stored Commands	• Absolute Time Tag Commands (ATS) • Relative Time Sequences (RTS) • Predefined Blocks of Commands (PDB)
Ephemeris Computation	• OBC Software Function • Uses Uplink or GPS Data • Landsat-D, TDRSS, Solar Ephemeris
Attitude Computation	• Local Vertical • Yaw to Orbit Plane • Stellar Acquisition • Earth Pointing • Orbit Adjust
Solar Array Orientation	• Open Loop • Closed Loop Using Coarse Sun Sensor
High Gain Antenna Pointing	• Program Track • Autotrack • Slew Direction and Rate (Timed) • Slew to Given Orientation • Advanced Turnaround Maneuver

Major On-Board Functions
Protective

Telemetry Monitoring	• Limit Checking • Execute an RTS or PDB or a Single Command (Optional) • Inhibit Stored Commands (Optional) • Telemetry Report
Failure Detection and Correction (FDC) Logic	• IRU • ACS Acquisition Modes • ACS Normal Modes • APCS Gimbal Drive/Resolver • Solar Array Drive
Safe Hold Attitude Control	• Earth Pointing or Inertial • Independent of OBC • Thrusters Enabled for Wheel Unloading

Flight Segment Activation

Early Orbit Timeline

EVENT	DAY 1	2	3	4	5	6	7	13	14
1. Separation	X								
2. Solar Array Deployment and Rotation	X	O →							
3. Attitude Control Activation	X	X	O →						
— Star Catalog Load		X			O →				
— Ephemeris Load		X	O →						
4. C & DH Activation									
— NBTR	X	O →							
— Command	X	O →							
— OBC Dump/Map	X								
5. Sensor/Wideband Activation									
— S Band Communications	X	X	O →						
— X Band Communications	X		X	O →					
— Multispectral Scanner		X	X	O →					
— Thematic Mapper (Bands 1-4)				X	O →				
(Bands 5-7)								X	O →

X = Activation/One Time Event
O = Operational

Early Orbit Timeline (Continued)

EVENT	DAY 1	2	3	4	5	6	7	13	14
6. Global Positioning System Activation		X→							
7. High Gain Antenna/Boom									
— Deployment		X							
— Initial Positioning		X							
— Initial Pre-TDRSS Exercise						X			
— Program Track Validation						X			
8. Orbit Injection Error Removal									
— Cal/Test			X						
— O.A. Burn				X					
— Vernier					X				

X = Activation/One Time Event
O = Operational

Launch and Early Orbit Procedures
(SVS-10147, Volume II Flight Activation)

6.1 Early Orbit Activation

6.2 Attitude Control (Stellar to Earth)

6.3 High Gain Antenna Boom Deployment

6.4 MSS Activation

6.5 TM Activation

6.6 TM & MSS Combination Activation

6.7 OBC Activation

6.8 Injection Error Removal

6.9 GPS Activation

6.10 High Gain Antenna Activation (Init.)

6.11 Wideband Communication Activation

6.12 High Gain Antenna Program Track Validation

Flight Segment Launch Configuration

COMMUNICATIONS AND DATA HANDLING

- Transponder
  - — To Omni Antenna
  - — Non-Coherent Operation
  - — Ranging Enabled
  - — GSTDN—Only Mode
- Telemetry
  - — Transmitter A On
  - — 8 KBPS Engineering Format
- Command
  - — 2 KBPS Rate

ATTITUDE CONTROL SYSTEM

- MACS B Enabled (Prime for Initial Acquisition)
- Hardware Powered
  - — Earth Sensors
  - — Fine Sun Sensors
  - — Magnetometers
  - — Magnetic Torquers
  - — Gyros
  - — Reaction Wheels
- Computer Status Monitor Enabled
- Narrowband Tape Recorder
  - — No. 1 Recording (From L-7 Min)
  - — No. 2 Off (End of Tape)
- On-Board Computer
  - — On With Self-Test Processors Executing
  - — Separation Detection Processor Executing
  - — Array Processor Enabled for Deployment
  - — Attitude Control Processor Enabled for Initial Acquisition
  - — Other Processors Not Enabled/ Executing (Nominal Ephemeris and Star Catalog Loaded)

PROPULSION MODULE

- All Thrusting Functions Disabled
- Latch Valves —Closed
  - —Drivers Disabled

Flight Segment Launch Configuration

POWER

- Internal Power On From L-15 Min.
- Configured to Charge All Batteries
- Computer Status Monitor Enabled

MULTISPECTRAL SCANNER

- In Launch Mode
  - — Shutter Rotating
  - — Otherwise Off

THEMATIC MAPPER

- In Launch Mode
  - — Door Magnets On
  - — Otherwise Off

WIDEBAND COMMUNICATIONS

- All Power Off

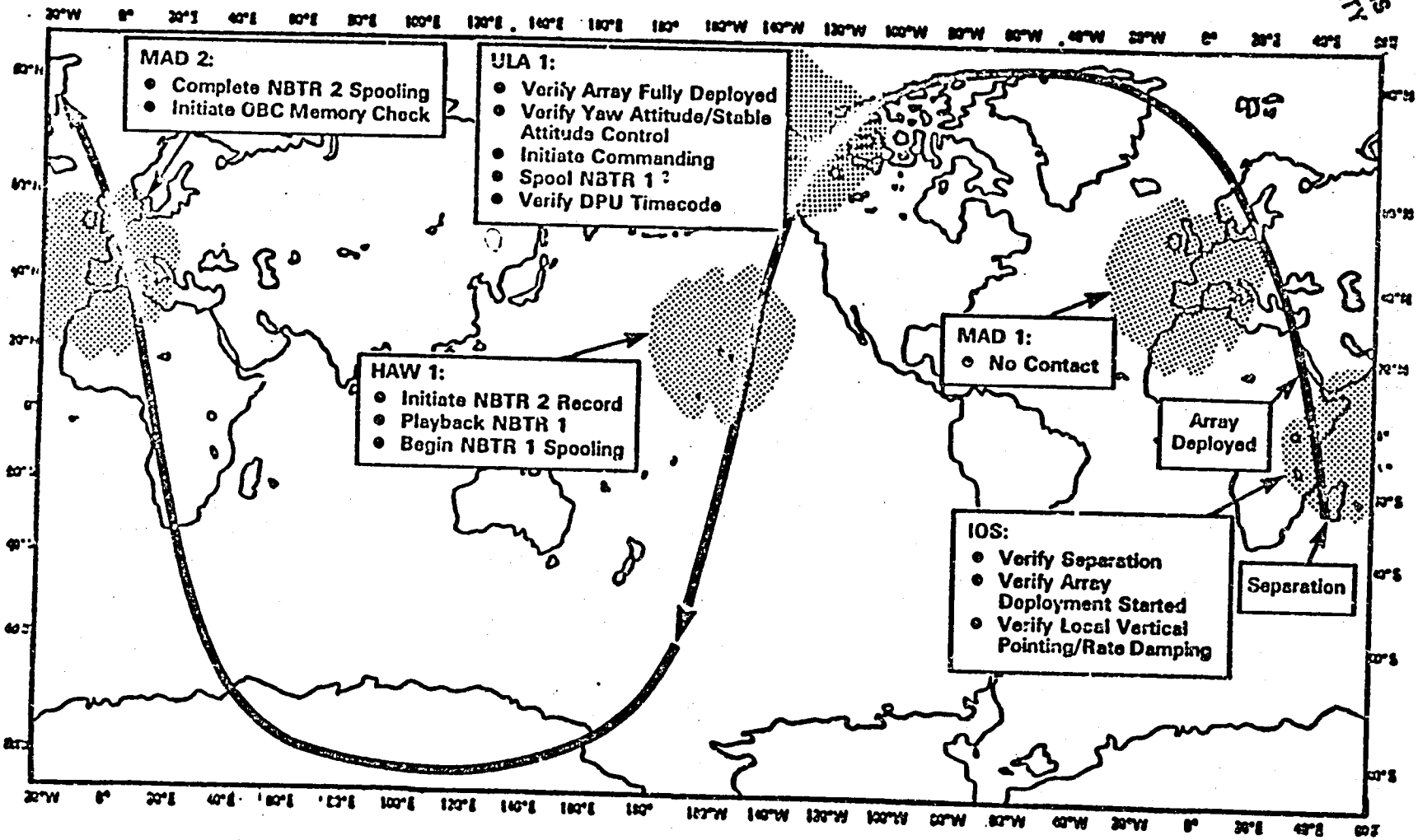
GLOBAL POSITIONING SYSTEM

- R/PA Memory
  - — Fully Loaded
  - — Standby

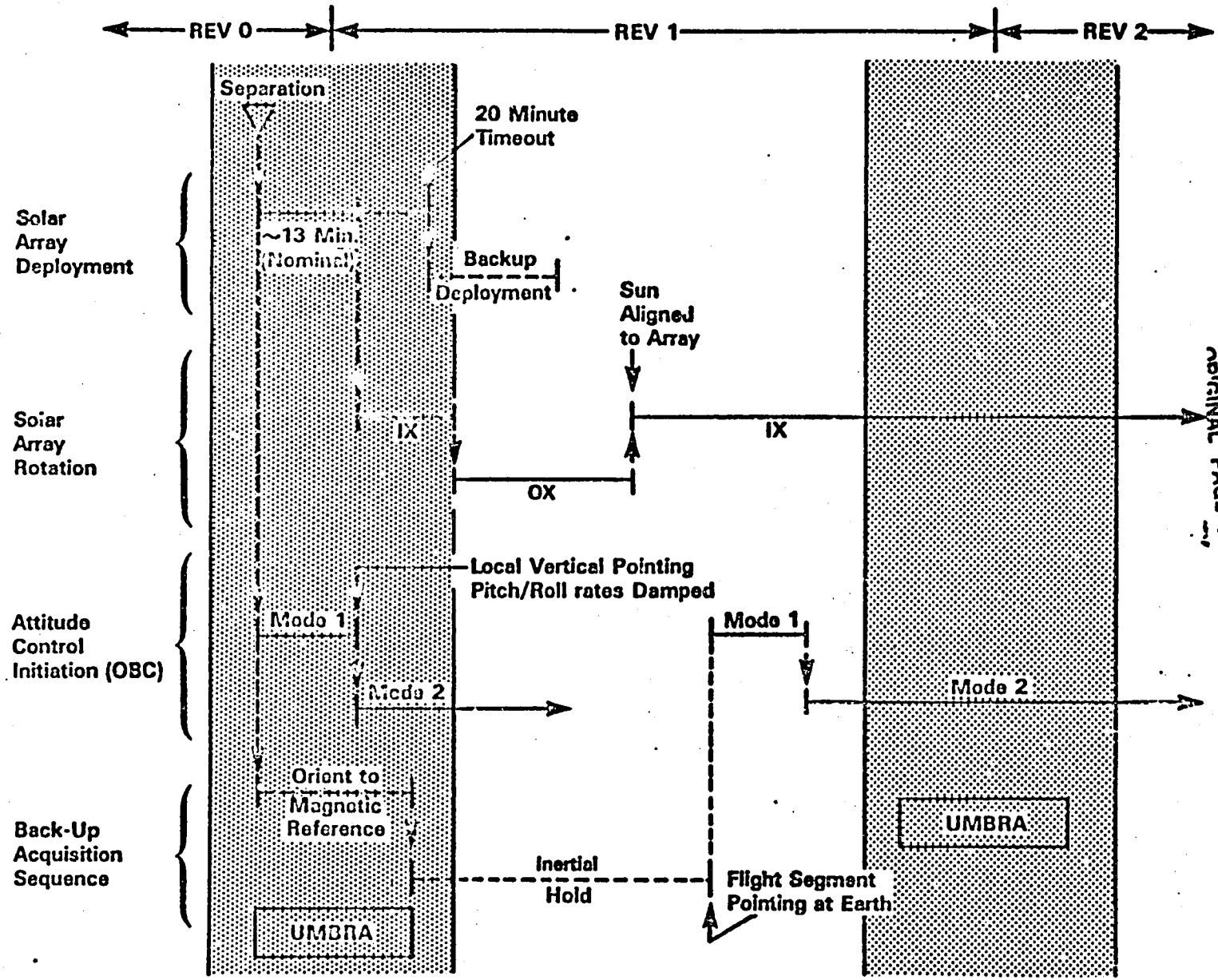
OTHER

- Thermal Control
  - — Selected Heaters On or Enabled
- Digital Processing Unit
  - — In Standby
- Signal Conditioning and Control Unit
  - — Power On
  - — Pyro Circuits Disabled

REV 0-2 Profile



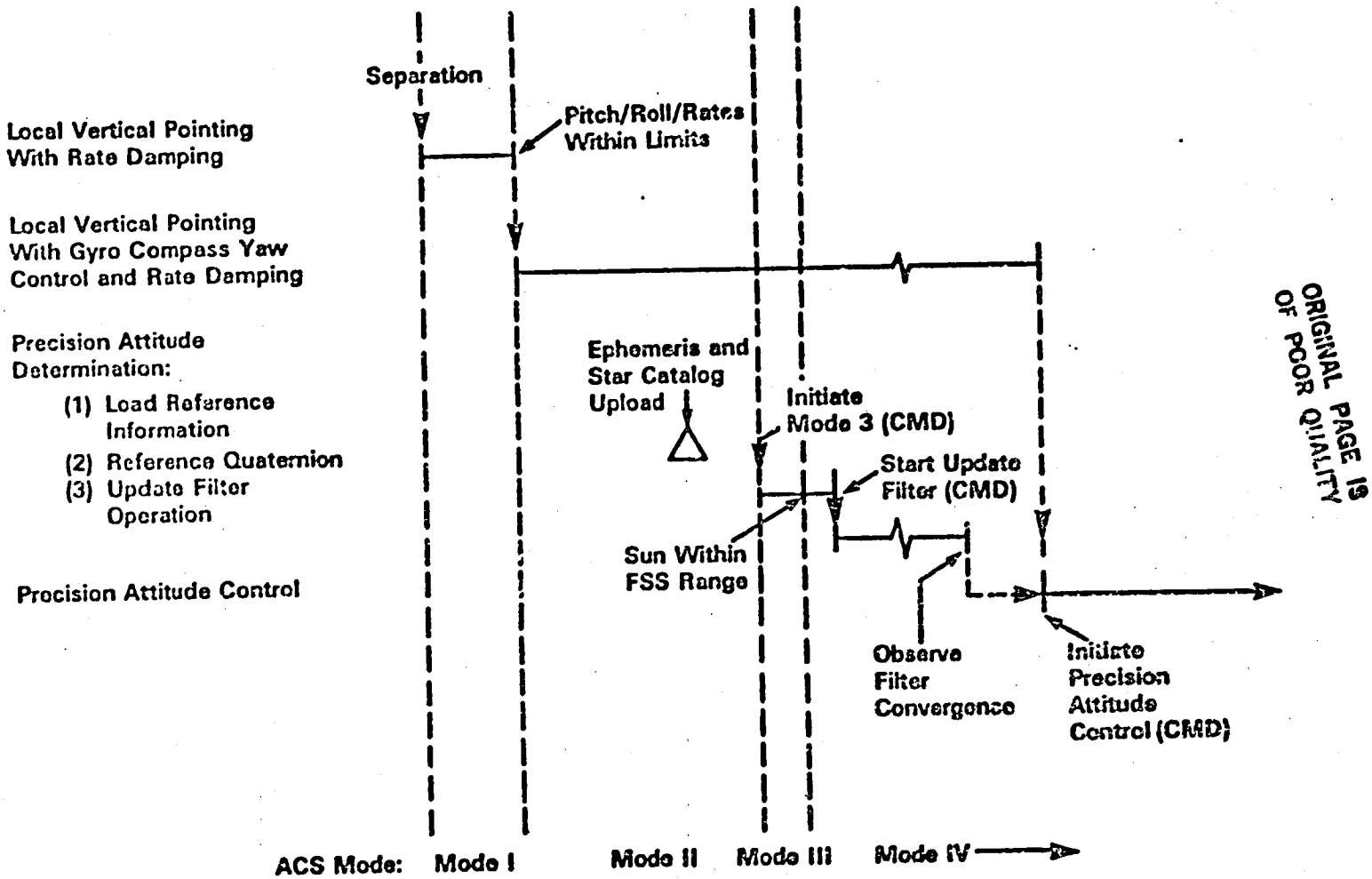
Post-Separation Activation Sequence



Solar Array Activation

- Post-Separation Sequence
  - — Closed Loop, Coarse Sun Sensor Control
  - — Changes Rate (0, 1, 2 X Orbital Rate) to Maintain Alignment
- Initiation of Normal Operation—Day 2/Rev 6
  - — Open-Loop Control (1 X Orbital Rate)
  - — Periodic Realignment to Sun as Required

ACS Activation

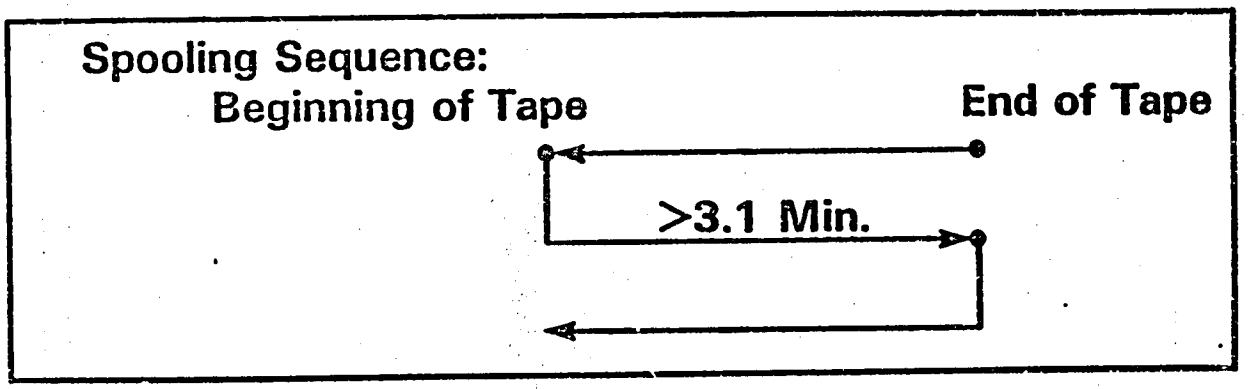


C & DH Activation

Narrow Band Tape Recorder—Day 1 Through Rev 1

— Launch: NBTR 1 Recording (From ~ 7 Min Prior to Launch
NBTR 2 Off at EOT

— 1 ULA: Spool NBTR 2/Begin Recording



— 1 HAW: Playback NBTR 1 (Direct)

— 2 MAD: Spool NBTR 1

C & DH Activation

COMMAND

- TIC/TOC Commands—Beginning Day 1/Rev 1
  - — Verify Real-Time Command Capability
  - — Spare Relay 1 Off (TOC)
  - — Spare Relay 1 On (TIC)
- Stored Command Capability—Day 1/Rev 2
  - — Verify Command Buffer Area
  - — Load/Dump All 1,0s Then 0,1s

C & DH Activation

OBC Memory Dump/Mapping—Day 1/Rev 2

- Dump OBC Memory
  - — Programs
  - — System Tables
  - — Telemetry Reports
- Compare to OBC Memory Map on the Ground
  - — Flag Differences
  - — Verify All Differences are in Dynamic Fields (i.e., Differences are Expected)

Wideband Communication Activation

X-Band:

- Power Converter On—Day 1/Rev 2
- 24 Hour Outgas Period*
- First Check With MSS Image Data—Day 3/Rev 28
  — Remains in Standby Thereafter

S-Band:

- 8 Hour Outgas Period*
- First Check With MSS MUX Data—Day 2/Rev 13

*Verified in Thermal Vacuum Testing

Multispectral Scanner Activation

- All Power Off—Day 1/Rev 2
- 10 Hour Outgas Period*
- Multiplexer Output Check—Day 2/Rev 13
  (Supports S-Band Link Activation)
- Each Band Checked Separately—Day 3/Rev 27

*Verified in Thermal Vacuum Testing

Thematic Mapper Activation

- Door Magnet Off
- Standby Heaters Enabled

} —Day 1/Rev 2

- Bands 1 - 4 Activation:
  - — 24 Hour Outgas Period*
  - — Sequential Turn-On—Day 4/Rev 42
- Bands 5 - 7 Activation:
  - — 6-Day Outgas Period*—Days 6 - 11
    Plus 1-Day Cool-Down*—Day 12
  - — Sequential Turn-On—Day 13/Rev 114

*Verified in Thermal Vacuum Testing

Sensor/Wideband Activation Sequences

SEQ. NO	ACTIVITY	LINK	DAY	REV
1	MSS MUX Data Only	S-Band	2	13
2	MSS (4 Ony, 1 Only, 2 Only, 3 Only, & 1-4)	S-Band	3	27
3	MSS (1-4), 85 PN	X-Band	3	28
4	TM (1, 1-2, 1-3, 1-4,)	X-Band	4	42
5	TM (1-4), MSS (1-4)	X-Band	4	43
6	MSS (1-4) and MSS (1-4), TM (1-4)	S-Band X-Band	5	57
7	TM (1-4 Plus 5, 7, 6)	X-Band	13	114

Note: All Sequences Using TGS and BLT

Global Positioning System Activation

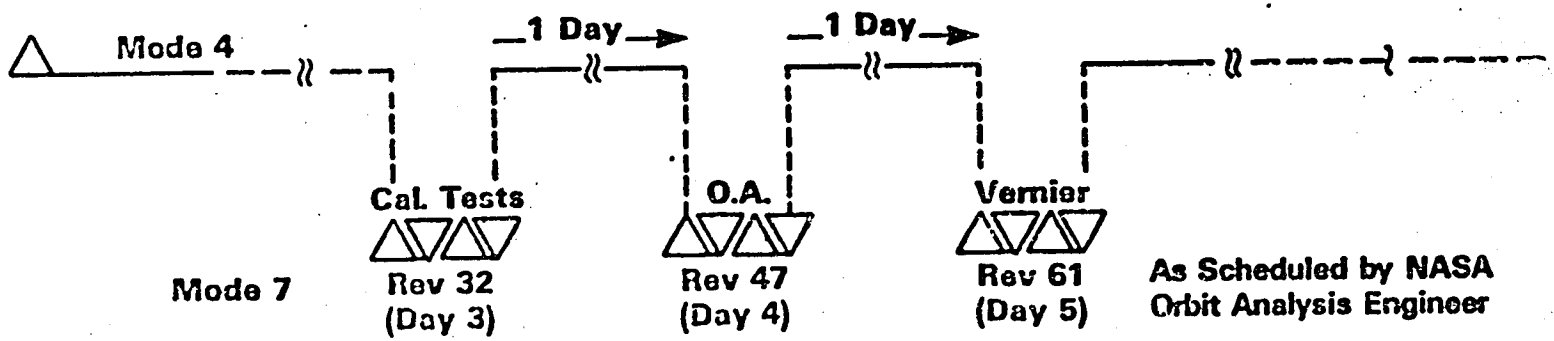
- GPS at Launch
  - — Memory Loaded
  - — Standby Mode
  - — NDS Almanac Loaded
  - — Landsat Almanac (Nominal Launch) Loaded
- Activate—Day 2/Rev 17
  - — Command to Navigate Mode
  - — Begin Telemetry Data Collection for MSCAD

High Gain Antenna/Boom Deployment Activation

- Boom Deployment—Day 2/Rev 17
  - — Before Orbit Adjusts Using Four 5 Lb. Thrusters
  - — Erect Boom; Antenna in Stowed Position
- Initial High Gain Antenna Positioning (Open-Loop Slew)—Day 2/Rev 17
  - — Elevate to Horizontal Position
  - — Execute ±5 Degree Exercises (Each Axis)
- Initial Pre-TDRSS Exercise—Day 6/Rev 73
  - — Three-Step Sequence:
    - (1) Elevate to Straight-Up Position—Single Axis Rotation
    - (2) Rotate (Azimuth) to +X—Single Axis Rotation
    - (3) Return to Horizontal −X Position—Concurrent Two-Axis Rotation
  - — Final Position Near Opposite Azimuth Stop
- Program Track Validation—Day 6/Rev 73
  - — TDRS Ephemeris Used
  - — Execute Program Track Mode
- Execute Advanced Turnaround Maneuver—To Be Scheduled

Injection Error Removal

- Injection Error Removal



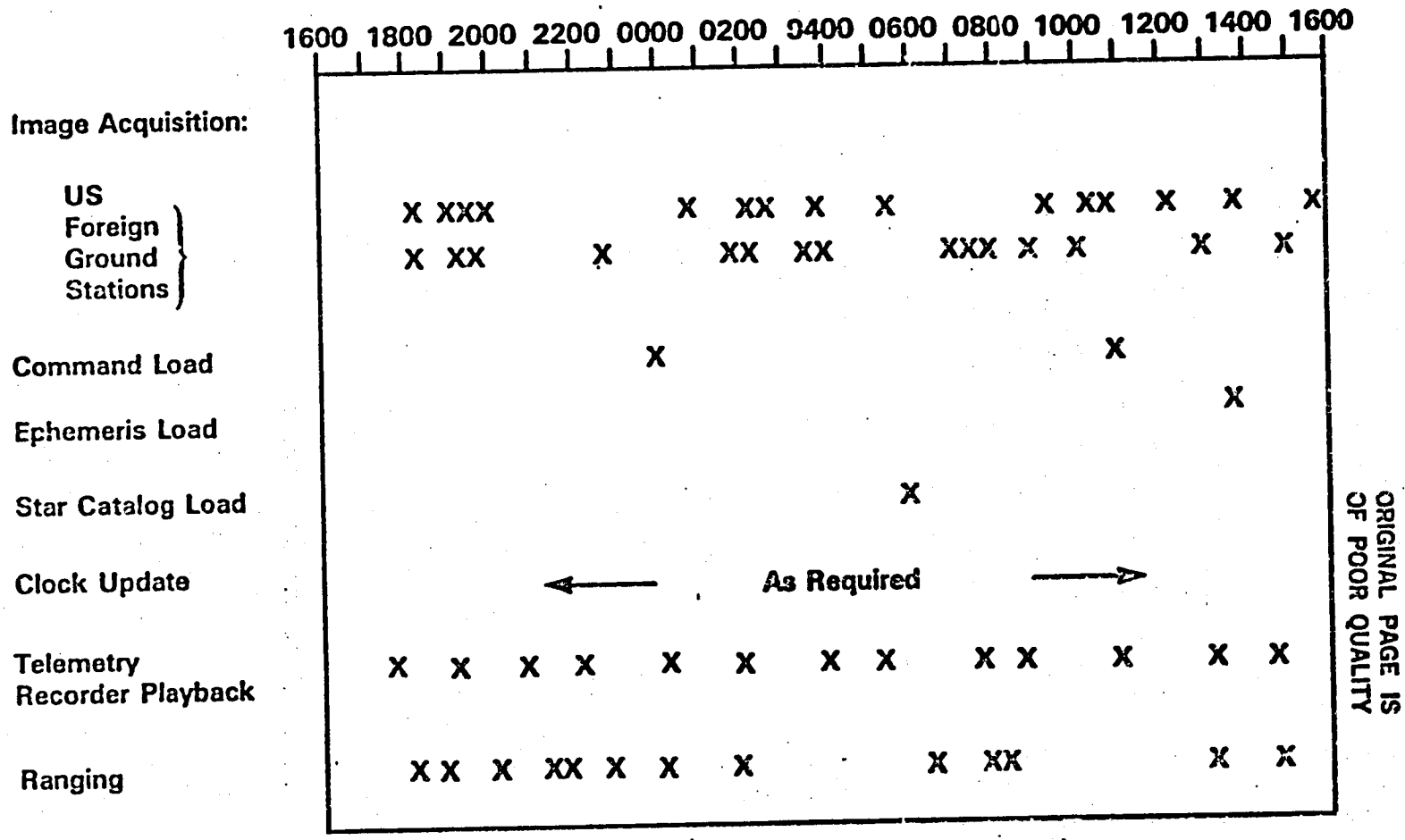
- Ranging

Normal Operations

Normal Operations

SHORT-TERM	FREQUENCY
• Instrument and Wideband Operation	Multiple Times Per Day
• NBTR Playback	
• Ranging	
• Stored Command Load	2 to 3 Per Day
• Solar Array Synchronization	Once Per Day
• Ephemeris Load	
• Clock Update	Daily as Required
• Star Catalog Load	Twice Per Week
• GPS Initialization	Weekly as Required
LONG-TERM	
• Drag Make-Up Maneuvers	Typically Monthly
• Pre-TDRSS Antenna Exercises	Every 45 Days
• TM Outgassing Cycles	As Required
• Leap Second Insertion	6/12 Months as Required
• Clock Recycle	Yearly
• Inclination Correction	Every 18 Months

Typical Daily Flight Segment Operation Profile



Normal In-Orbit Procedures
(SVS-10147. Flight Operations Plan for OCC)

7.1 NBTR Operations
7.2 Stored Commands Load/Dump
7.3 OBC Ephemeris Load/Dump
7.4 OBC Star Catalog Load/Dump
7.5 System Table(s) Load/Dump (General)
7.6 DPU Clock Update
7.7 GPS Operations
7.8 TM and MSS Operations and Wideband Communication Control
7.9 TM Cooler Door/Outgas Activity, Periodic
7.10 C & DH Activity
7.11 Range and Range Rate Support
7.12 TDRS High Gain Antenna Hardware Test, Periodic
7.13 TDRS High Gain Antenna Maneuvers
7.14 TDRS High Gain Anenna Link Acquisition
7.15 GSTDN Station Link Acquisition
7.16 Solar Array Maneuvers
7.17 TDRS High Gain Antenna Operation
7.18 Orbit Maintenance/Drag Makeup
7.19 Inclination Orbit Adjust
7.20 Retrograde Orbit Adjust
7.21 Thermal Management
7.22 Array Synchronization
7.23 Quiescent Flight
7.24 Ephemeris Source Control
7.25 Leap Second/Year Transition
7.26 GPS Coordinate Transformation Update
7.27 GPS Corrected Time Offset Update
7.28 Gyro High Rate Calibration Mode
7.29 C & DH RF Switch Configuration
7.30 Fuel Remaining
7.31 Power Management

Command Operations

Real-Time

- NBTR Playback
- Star Catalog Update
- Ephemeris Update

Stored/Relative Time Sequence

- Telemetry Monitor (Response to Out of Limits Conditions)
- Orbit Adjust Maneuvers
  - — Solar Array Positioning
  - — Latch Valve Configuration

Stored/Absolute Time-Tagged

- Sensor Operation
- Wideband Operation
- Communications & Data Handling Operation
- Orbit Adjust Maneuvers
  - — Mode Control

Stored/Predefined Blocks

- Telemetry Monitor (Response to Out of Limits Conditions)

Basic Telecommunication Operations

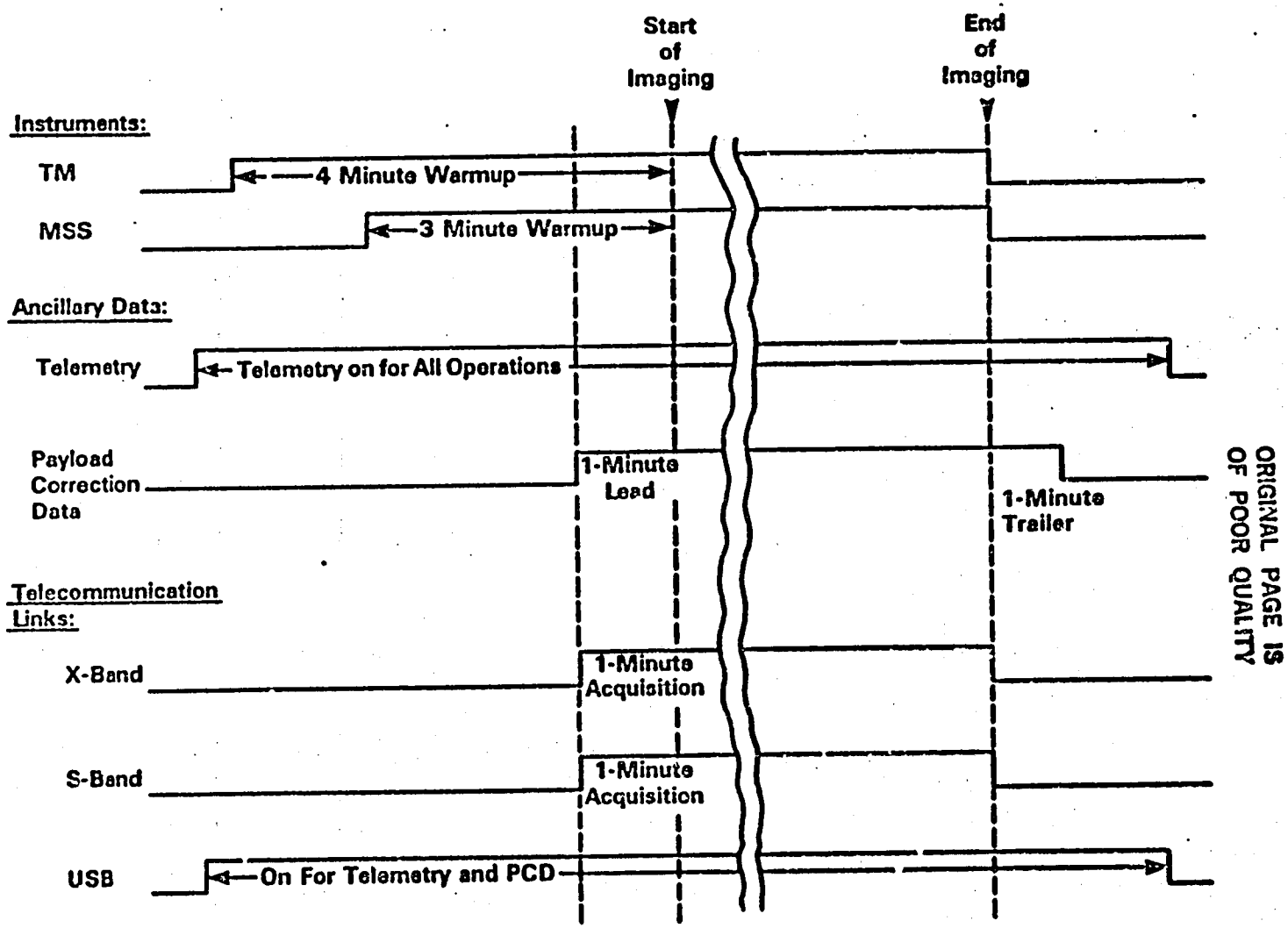
USB Link:

- FS Radiates From AOS-1 Min. to LOS + 1 Min. (Via Stored Command)
- Station Receives/Radiates After Lock
- Command Transmission in Burst Mode

Direct Read-Out Links:

- FS Radiates to Support 1 Min. Acquisition Period Prior to Data of Interest
- Modulated With Sensor and/or PN Data Throughout

Imaging Operations



NBTR Operation

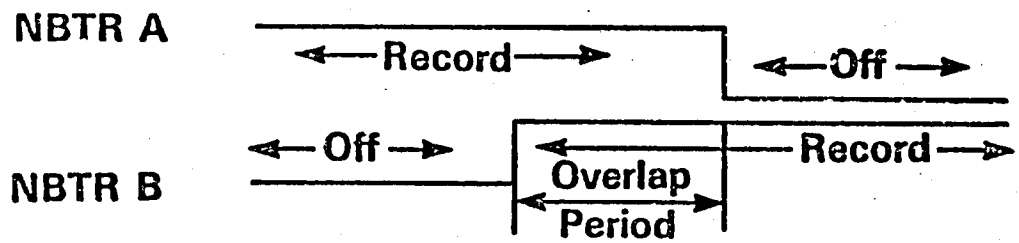
Planned Use:

- — Continuous Recorder Coverage Over First Year
- — Optional Reduction to Coverage Only Between TDRSS Service Periods Thereafter

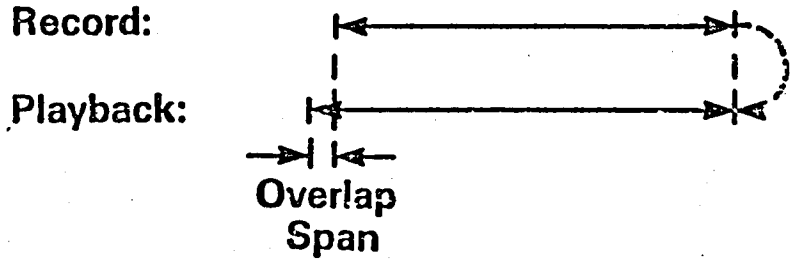
Operation Plans:

(1) Initial Spooling to Align Tape Stack

(2) Provide Overlap at Recorder Transition



(3)Playback Spans Overlap Record Start-Points:



Ranging Operation

- 10-13 Operations Per Day; 5-10 Minutes Each
- Transponder Into Coherent-Mode Operation for Doppler Measurements
- GSTDN Ranging Requires Use of USB Baseband—Shared With:
  - — NBTR Playback
  - — OBC Memory Dump
  - — Payload Correction Data

On-Board Computer Load Operations

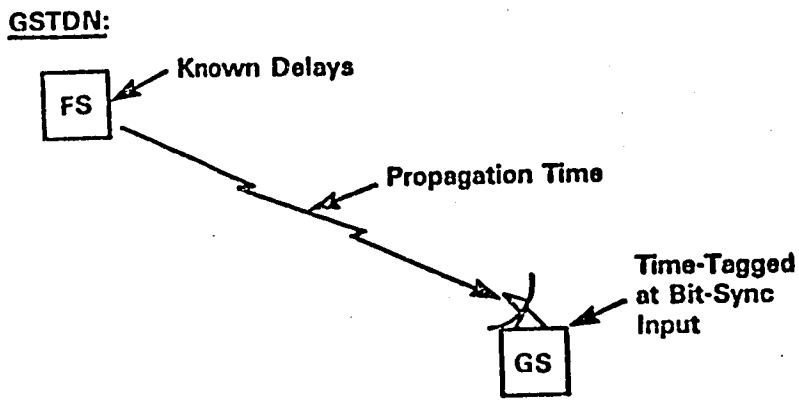
- Table Loads Transmitted in Real-Time Command Sequences
- Verification Via Selective Dump
- Selected Tables Disabled or Buffered to Permit Load/Verify Before Use:

DATA TYPE	SPLIT-BUFFER	DOUBLE-BUFFERED	TABLE USE DISABLED
Stored Commands	X		
Ephemeris Parameters		X	
Star Catalog		X	
Telemetry Monitor Values			X

Solar Array Maneuvers

- Synchronization:
  - — Monitor Position Relative to Sun
  - — Resynchronize Only During Non-Imaging Period
  - — Stop/Accelerate Array Rotation to Correct Position
- Orbit Adjust Support
  - — Advance Array to Anticipate Stopping for Orbit Adjust
  - — Stop Array During Thruster Operation

Flight Segment Clock Updates



Clock Monitoring:

- Up to Every Contact

Time Updates:

- ΔT Adjustment
- Inserted at Preselected Time
- Scheduled to Avoid Imaging Periods

Annual Recycle:

- Reload Time Value Plus Error Removal Via ΔT Adjustment
- Scheduling Synchronized to Other Clock System Updates

Global Positioning System Operation

Operation Initialization:

- Landsat, NOAA Almanac Inputs
- Mode Control
- Time Code Generator Set

Telemetry Output Management

- Data File Selection (Additions, Deletions)

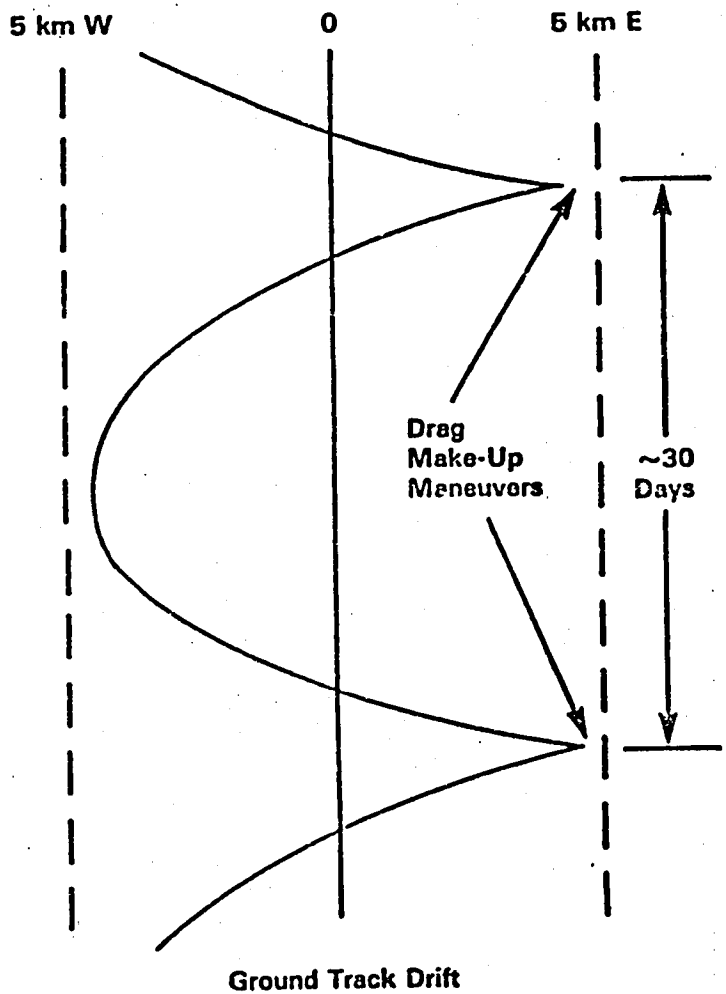
Utilization Control

- Verification Against OBC Parameters
- Corrected Time Offset (CTO) Update
- Control Input Verification

Memory Maintenance

- R/PA Data Base Parameter Updates

Orbit Adjust Drag Make-Up



Frequency: 30 Days
(20-30 Over 3 Years)

ACS: Normal Mode

PM1A: Two 5-Lb. Thrusters
(3 Second Burn Time)

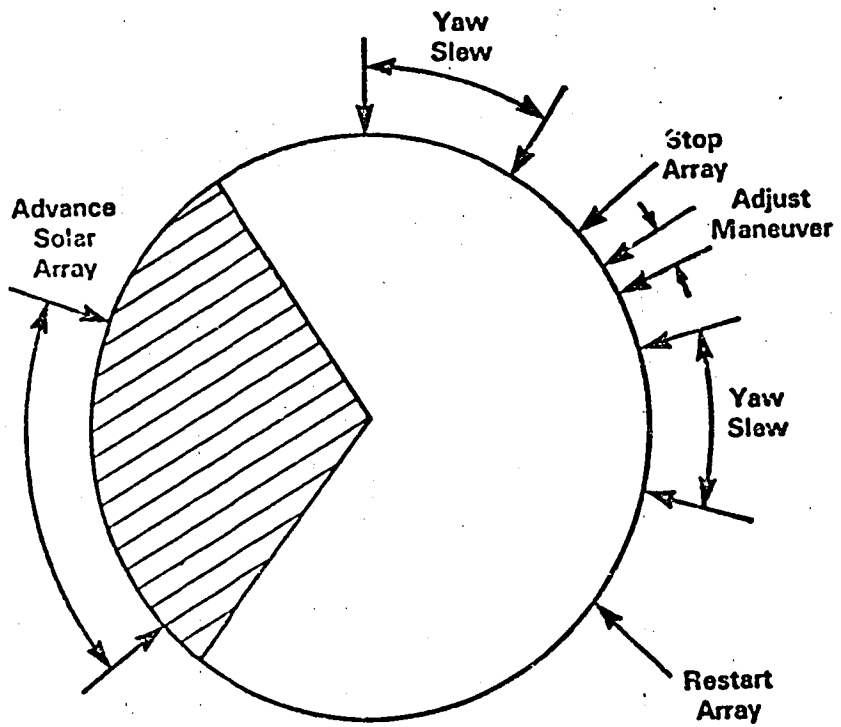
Total
Propellant
Required: 3-5 Lbs. (Over 3 Years)

Mission
Considerations:

(1) ~One Orbit Required to Fully Restabilize

(2) Uplink Ephemeris Replacement Available Eight Hours After Maneuver

Orbit Adjust Inclination



Purpose:

- Reversal of Sun Angle Drift (Return Toward 9:30 AM)

Frequency: After 18 Months

ACS: 90°-Yaw Position (With Bias to Avoid Retrograde Maneuver)

PM1A: Four 5-Lb. Thrusters (2 Minute Burn Time)

Total Propellant Required:

20-25 Lbs. (One Maneuver)

Mission Considerations:

- Same as Drag Make-Up

Orbit Adjust—Retrograde

- Used to:

  (1) Recover From Excessive Pre-Separation Delta Burn, Misalignment (<90° Yaw) During Inclination Orbit Adjust, or Posigrade Orbit Adjust Overshoot

  (2) Descend to Shuttle Retrieval Altitude

- Required Operations:

  — Array Advance

  — 180° Rotation of FS

  — Two 5-Lb. Thrusters (for Recovery Use), or Four 5-Lb. Thrusters (for Descent)

  — One Lb. Propellant Per km Descent

Contingency Plans

Major On-Board Functions
Protective

Telemetry Monitoring	• Limit Checking • Execute an RTS or PDB or a Single Command (Optional) • Inhibit Stored Commands (Optional) • Telemetry Report
Failure Detection and Correction (FDC) Logic	• IRU • ACS Acquisition Modes • ACS Normal Modes • APCS Gimbal Drive/Resolver • Solar Array Drive
Safe Hold Attitude Control	• Earth Pointing or Inertial • Independant of OBC • Thrusters Enabled for Wheel Unloading

Flight Segment Contingency Procedures (SVS-10147, Flight Operations Plan for OCC)

		ACT	OPER
F.1	Attitude Control Re-Acquisition		X
F.2	OBC Telemetry Monitor Action/Recovery		X
F.3	High Gain Antenna Bias Update		X
F.4	Safehold Detection	X	X
F.5	STACC/OBC Fault Isolation and Recovery		X
F.6	GPS Out-of-Tolerance Conditions		X
F.7	Backup Earth Acquisition Mode		X
F.8	Momentum Management		X
F.9	OBC Program Load and Dump	X	X
F.10	TDRS Link Blind Acquisition (KSA, SSA)		X
F.11	Power Management, Single Battery Off		X
F.12	Solar Array Drive Anomalies	X	X
F.13	Realtime Telemetry Loss/Recovery	X	X
F.14	MACS/OBC Calibration Bias Update (Gyro)		X
F.15	Payload Instrument Pointing		X
F.16	DPU Time Code Loss/Recovery	X	X
F.17	Payload Data Loss/Recovery		X
F.18	Powered Down Spacecraft Configuration		X
F.19	Solar Array Deployment	X	
F.20	GPS Memory Load and Dump		X
F.21	Software/DPU Time Sync	X	X
F.22	Emergency Orbit Adjust	X	
F.23	Safehold Recovery	X	X

On-Board Contingency Protection

Solar Array — Backup Deployment
— Backup Rotation Drive } Using Alternate Equipment

Attitude Control — Backup Initial Acquisition Sequence
(1) Orient to Magnetic Field
(2) Hold Inertial Attitude
(3) Wait for Earth to Come Into View
— Backup Operation Using Alternate Equipment
— Safehold Mode Operation

On-Board Computer — Transfer to Safehold Upon Loss of Check Signal

High Gain Antenna — Discontinue Gimbal Drive if Control Loop Error Exceeds Limits

Other Equipment — Discontinue/Inhibit Operation if Telemetry Measurements Exceed Limits

Telemetry Monitor Processor

Functions:

(1) Monitors Analog Function Levels (Currents, Temperatures) Against Mode-Dependent Limits

(2) Issues Equipment Shutdown Commands if Out-of-Limit Condition is Detected

(3) Inhibits Stored Turn-On Commands Once Equipment is Shut Down

Planned Use:

- Mixed Active/Passive Operation
  - — Regular Use of Active Capability to Protect Flight Segment Equipment
  - — As-Required Use of Passive Capability to Aid in Performance Analysis

First-Contact Contingency Plans

No Contact at Alaska:

- Utilize Short, Long Burn Acquisition Data (AOS and LOS Times, Antenna Pointing Angles)

Contact/No Telemetry:

- Command Solar Array Deployment
- Reconfigure Telemetry Equipment

No Separation Switch

- Command Solar Array Deployment
- Command Initiation of Attitude Control Acquisition (OBC)

Array Not Deployed:

- Release Array Via Real-Time Command

High Angular Rates:

- Command Into Safehold Earth Pointing Mode
- Enable Thrusters

OBC Program Load/Dump Plan

- For Use in Replacing OBC Memory Content and/or Verifying Content in Place
- Flight Segment Into Safehold During Load Operation
- Upload Each Memory Bank—(~ 5 Minute Operation)
- Verify Each Memory Bank as Loaded

Imaging Contingency Plans

Payload Data Loss/Recovery:

(1) Shut Down Transmitters to Avoid No-Modulation Operation
(2) Reconfigure for Down Link Modulation
(3) Verify Sensor Operation Via Telemetry
(4) Reinitiate Down Link Transmission

Payload Instrument Pointing:

- To Compensate for Offsets Between Instrument Optical Axes and ACS
  - (1) Determine Offsets From Control Point Processing Results
  - (2) Update ACS Bias Values in OBC

Solar Array Drive Contingency Plan

- To Position Array For Optimum Power Collection With Drive Inoperative (When Drive Failure Appears to Be Imminent)
  - — Advance Array to High-Noon Position
  - — Disable Drive

Flight Segment Clock Contingency Plans

- DPU Timecode Loss/Recovery:
  - — Recover From Loss of DPU Time Code (Due to Hardware Reconfiguration or Other Causes)
    - (1) Select Redundant DPU (if Required)
    - (2) Reload Time Code Value
    - (3) ΔT Adjustment
- Software/DPU Time Synchronization:
  - — To Synchronize OBC Clock to the DPU
    - (1) Schedule Resync to Avoid Disturbing FS Operation
    - (2) Command OBC Spacecraft Control Processor to Resynchronize

GPS Contingency Plans

- GPS Out-of-Tolerance Condition
  - — To React to GPS Data Divergence From OBC Ephemeris Values
    - (1) Disable GPS Utilization (if in Use) and Enable Uplink Ephemeris
    - (2) Verify R/PA Safety—Shut Down if Necessary
    - (3) Notify MSCAD
- GPS Memory Load/Dump
  - — To Reload/Replace R/PA Memory Content and/or Verify Memory Contents
  - — Load/Verify in Five-Minute Increments (~6-12 Hours for Full Load Activity)
  - — Full Initialization Following Reload
    - (1) NDS Almanac
    - (2) Landsat Almanac
    - (3) Time Code Generator Set
    - (4) Telemetry Data File Selection
    - (5) Corrected—Time Offset (OBC Value)

STACC/OBC Fault Isolation/Recovery Plan

- Utilize Telemetry Reports
  - — Status Buffer
  - — Executive Status Report
- Utilize Hardware Dump Capability to Isolate Problem
  - — No OBC Contribution to Telemetry
  - — Check Status Buffer
  - — Check Executive Status Report
- Switch to Alternate Hardware

Other Contingency Plans

- Power Management (Single Battery Off):
  - Disconnect Battery to Recover From Unbalanced Charge Condition
  - Adjust Operational Scheduling Parameters During Two-Battery Operation
- Minimum Power Configuration:
  - Minimum Transponder Timelines
  - Both Sensors and WBCS Off (Except High Gain Antenna)
  - GPS Off
  - One/Both NBTR Off
  - Safehold
  - Closed-Loop Array Control
- MACS/OBC Calibration (Gyro Bias Update):
  - Utilize Gyro/Star Tracker Performance Data To Establish Gyro Drift Rates
  - Update ACS Processor Drift Compensation Values

Control Center Operations

- Overview
- Operator Interfaces
- Planning and Scheduling
- On-Line
- Performance Analysis
- Acquisition Analysis
- Test and Simulation
- Early Orbit and Contingency
- TGS

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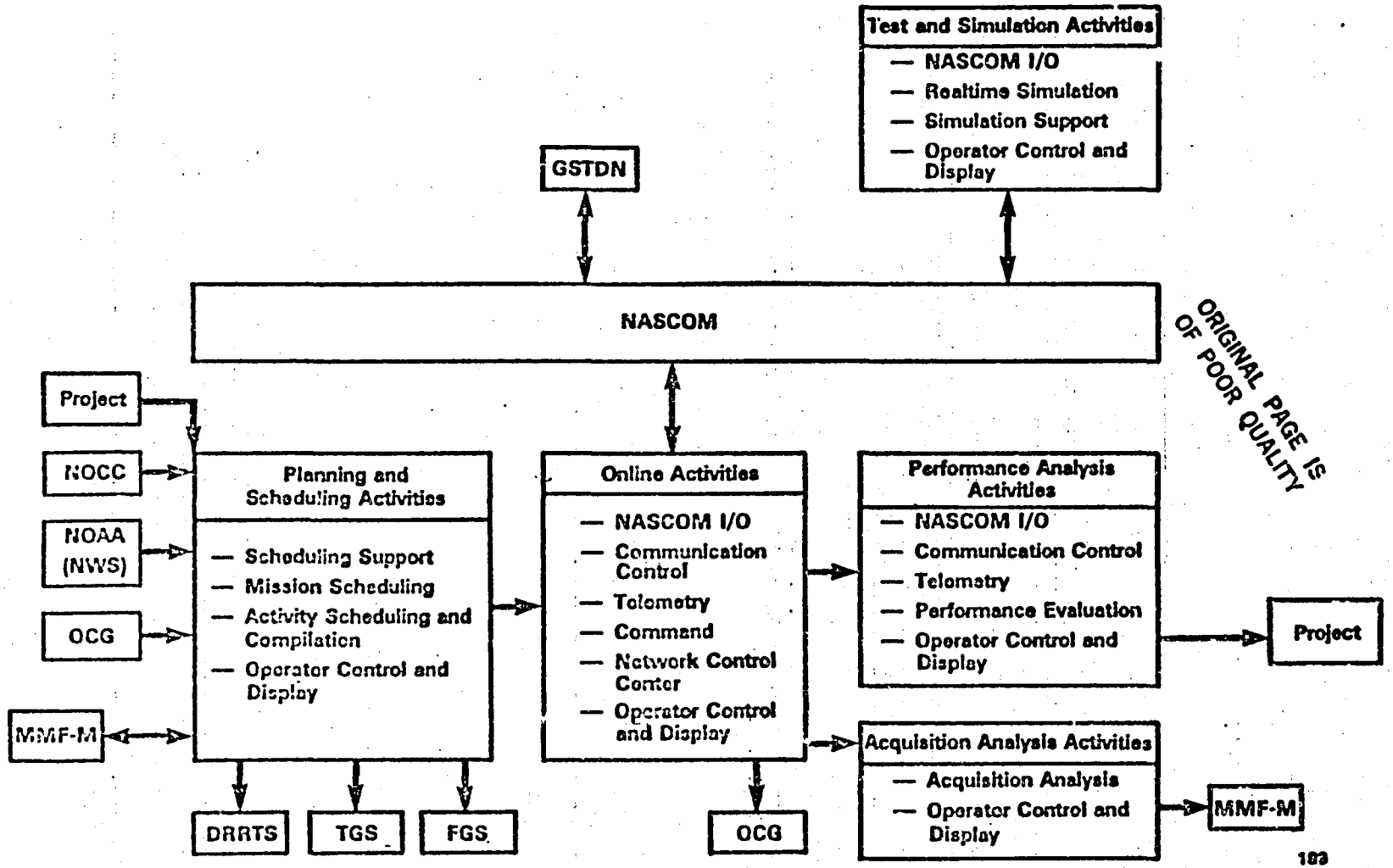
Typical Day—GSTDN

- 24 Hour Per Day Operations
- ~20 Real Time Contacts
- Daily Scheduling
- 1 Orbit In-Depth Analysis

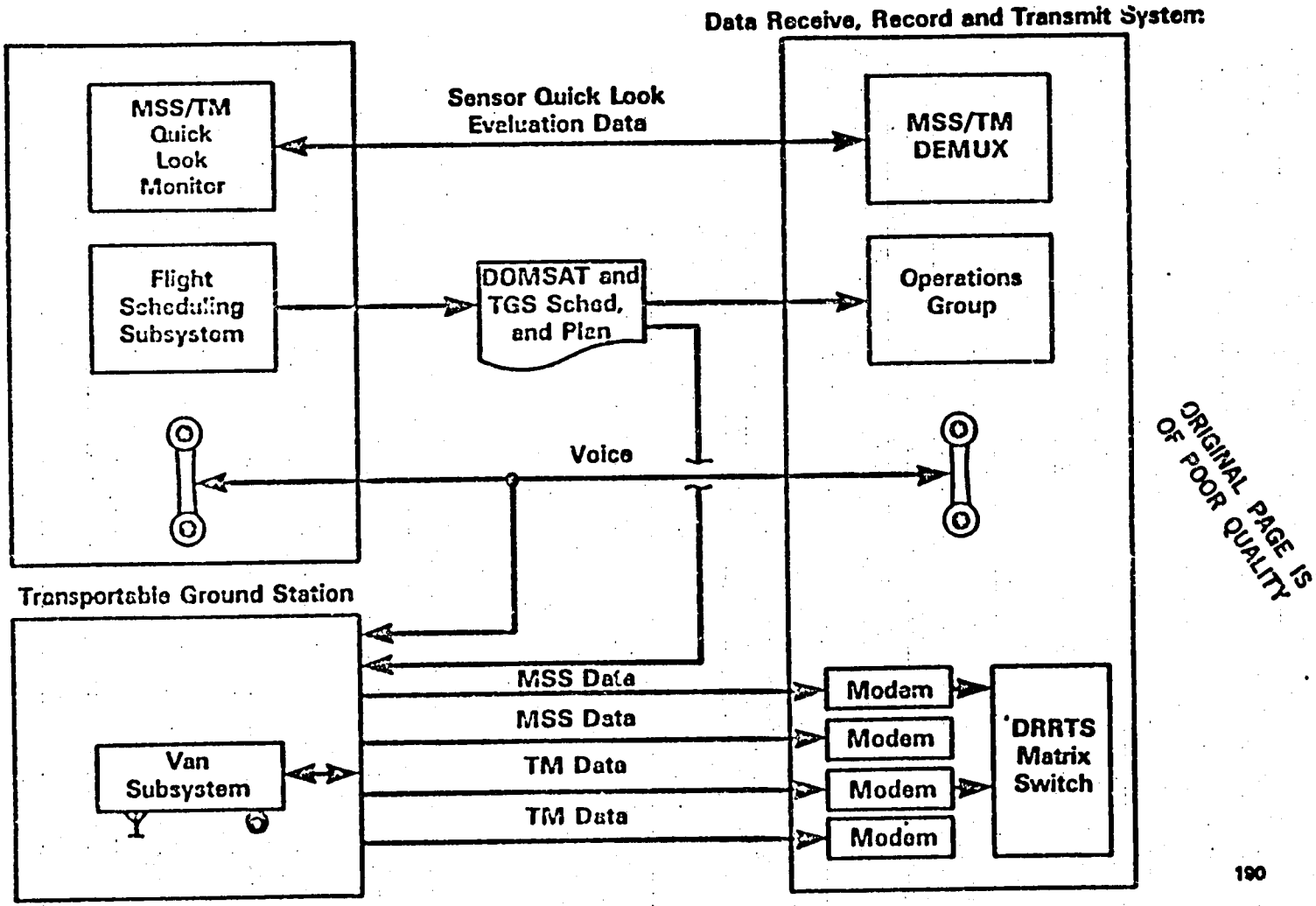
Plus

- Test and Simulation Activities
- Software Development
- Weekly Planning

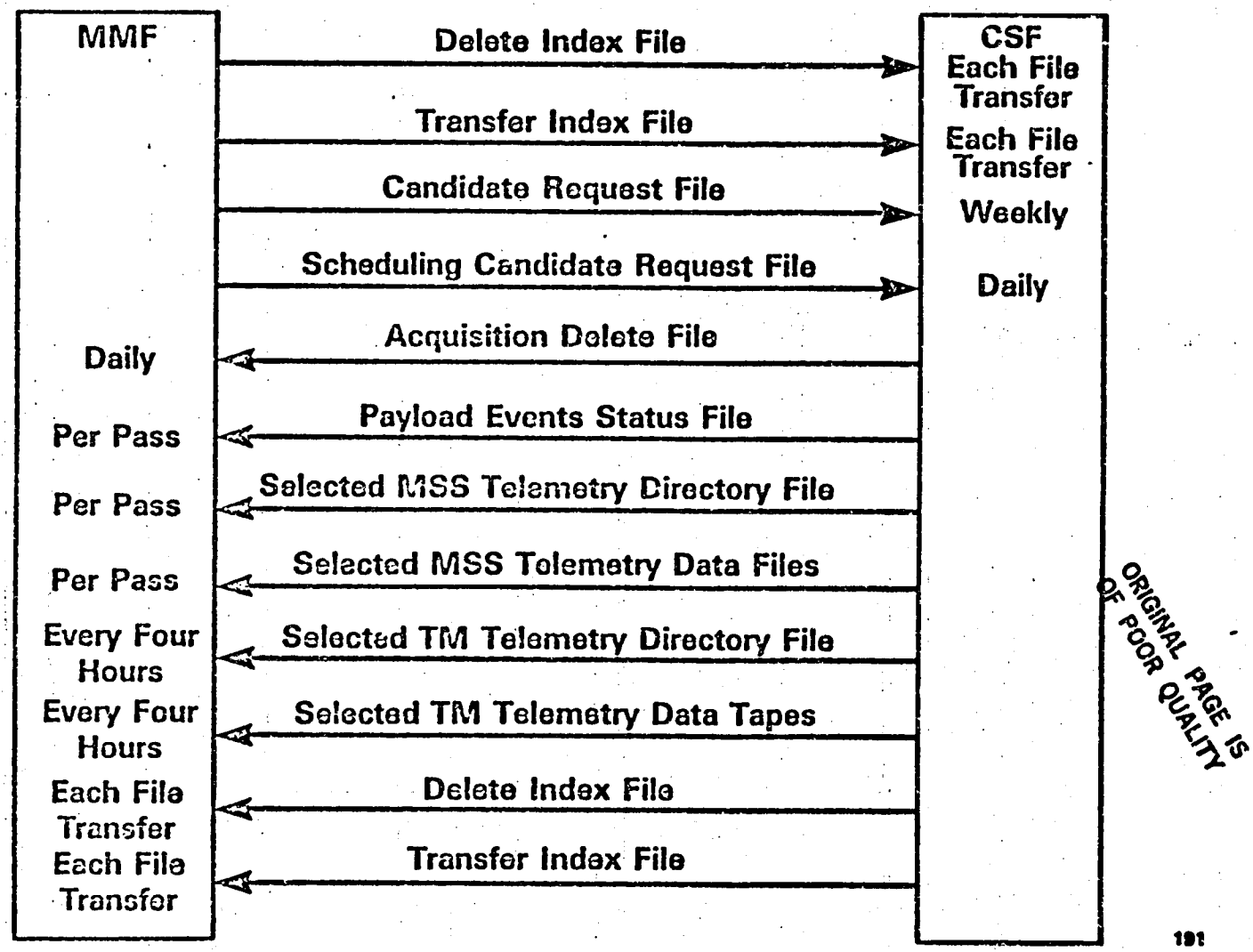
Control and Simulation Facility Overview



CSF to Data Receive, Record and Transmit System Interface Overview



Functional Diagram of MMF to CSF Interface



Control Center Operations

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Operator Interface

- DCL —Digital Command Language

  Defined in DEC Manuals

- TOIL—TSIM Operator Interface Language

  Defined in TSIM Users Guide (LSD-CSF-SUM-0004)

- COIL—CSF Operator Interface Language

  Defined in COIL Users Guide (LSD-CSF-SUM-0001)

CSF Language

- Language is CSF Operator Interface Language (COIL)
- COIL is Similar to STOL as Defined in X-108-77-100
  - — Features Found in X-108-77-100 but Not in COIL Are:
    - (1) Conditional Perform—Block
    - (2) Arithmetic Expressions
  - — Features Implemented in COIL but Not in X-108-77-100:
    - (1) NASCOM Directives and Catalogs
    - (2) Switching Unit Directives
    - (3) Inquire Directive and General File List
    - (4) Planning and Scheduling Directives
    - (5) Performance Evaluation Directives
- Allows Manual Procedures to be Automatic

C-3

COIL Syntax

TIME TAG	DIRECTIVE	ARGUMENTS	!COMMENT
TIME TAG	= YYYY:	ddd: hh	: mm :ss
DIRECTIVE	= UP TO 15 ALPHANUMERICS BEGINNING WITH A LETTER		
ARGUMENTS	= A LIST OF ONE OR MORE ADDITIONAL PARAMETERS SEPARATED BY A COMMA OR BLANKS		
COMMENT	= ANY PRINTABLE ASCII CHARACTERS		
EXAMPLE:			
12:00:00	SNAP POWER , TAKE A HARDCOPY OF POWER		

Sample Procedure

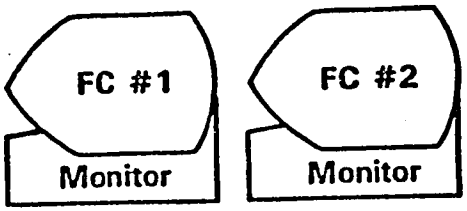
- Procedure Enabled by Operator Typing—Start Passwrap

```
PASSWRAP.PRO;4                    9-SEP-1981.12:14:11.78        PAGE 1

   10   PROC PASSWRAP
   20   !
   30   !
   40   !        TERMINATE THE PASS.OPERATIONS
   50   !
   60   CHART <SCR> OFF
   70   /TERMCMD
   80   ACQ OFF TLM
   90   ACQ OFF PCD
  100   ACQ OFF OBC
  110   EXTIME OFF
  120   EXTRACT OFF
  130   TLM OFF
  140   HISTORY OFF TLM
  150   VERIFY TERM
  160   NIF DIS A<CMD32K>
  170   NIF DIS A<TLMCHAN>
  180   NIF EXI
  190   LOG OFF
  195   $PRINT OPERATOR_LOG
  200   END PROC
```

Operator Control Configuration

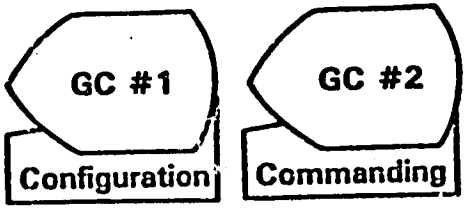
Control Console #2



Flight Controller

- Monitor GS
- Monitor FS

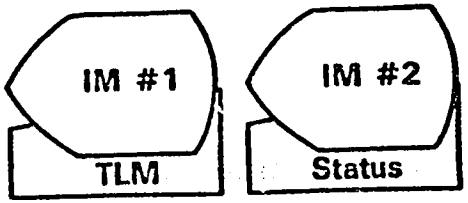
Control Console #1



Ground Controller

- S/C Command
- External Support
- Internal Resource Configuration

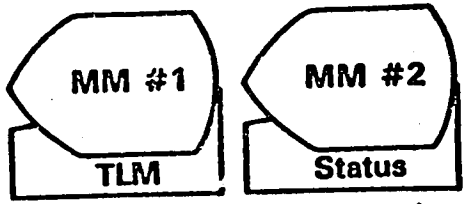
Control Console #4



Instrument Module Evaluator

- Instrument System Monitor

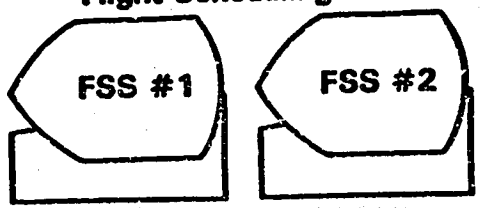
Control Console #3



Multi-Mission Spacecraft Evaluator

- Service Systems Monitor

Flight Scheduling Station



Flight Operations Planner

- Flight Segment Scheduling
- TSIM Control
- Back Up to FOS

Control Center Operations

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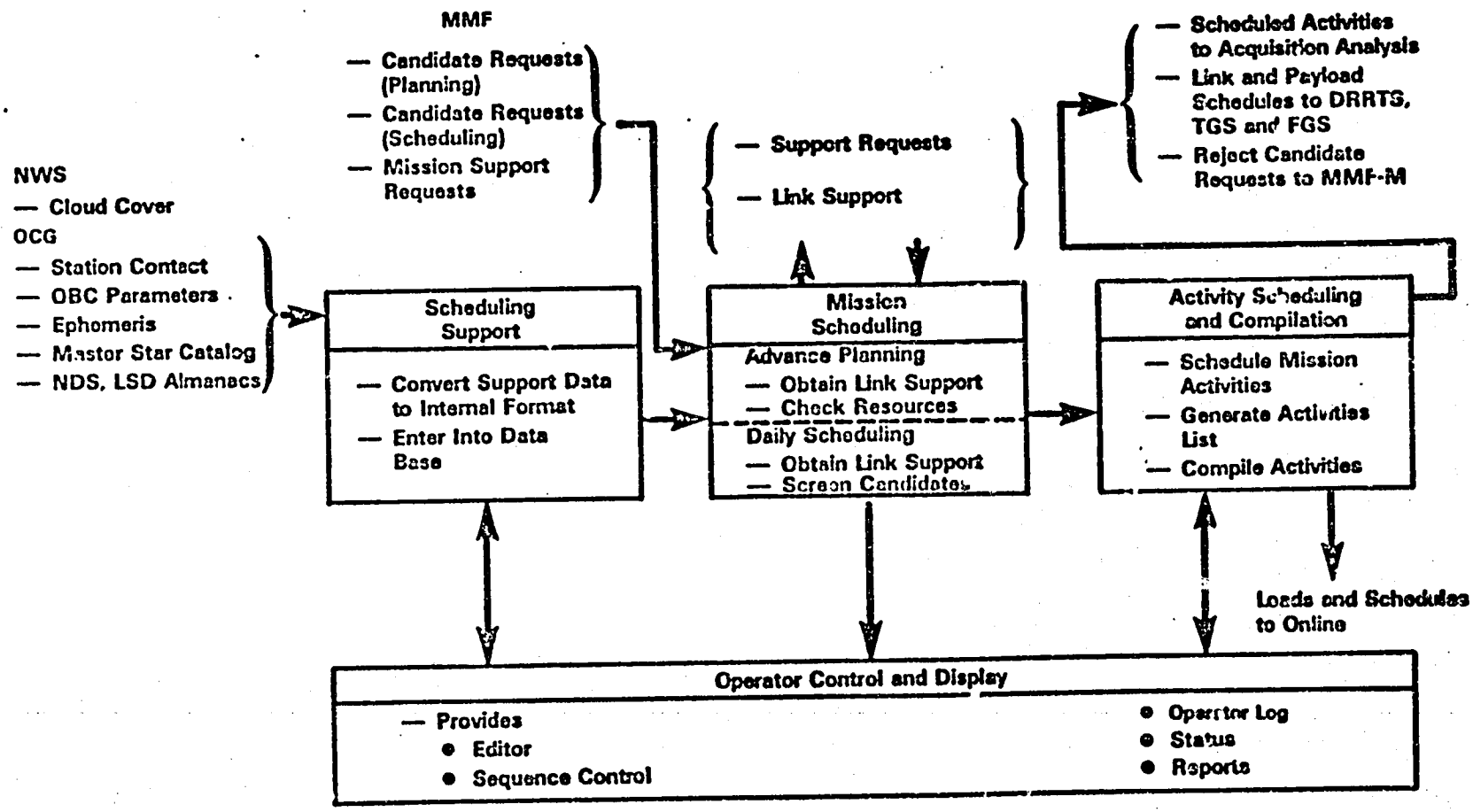
Planning and Scheduling Activity Flow



Planning/Scheduling Resource Requirements

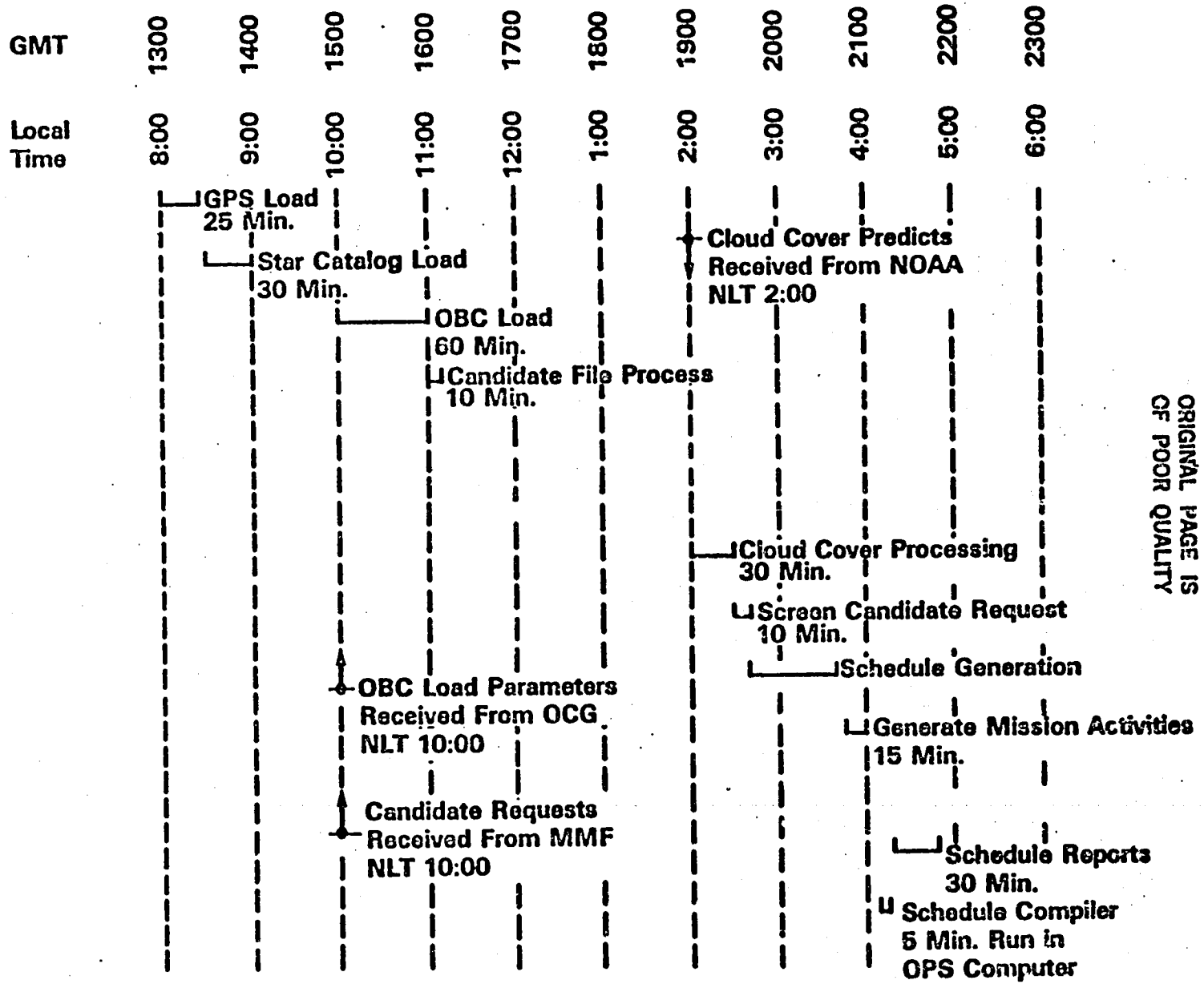
Planning

- Requires Flight OPS Planner
- Operate Weekly to Generate Schedule
- Uses One VAX ~ 12 Hours/Week
- Communicate to NOCC Via CAIRS Panel and Teletype

Scheduling

- Requires Flight OPS Planner/Ground Controller
- Operate Daily to Generate 24 Hour Schedule for Flight Segment Operation and Ground Control
- Uses One VAX ~ 6 Hours/Day

Daily Scheduling Timeline



Planning Display—Payload Planning

```
CONTROL AND SIMULATION  FACILITY  -  PAYLOAD PLANNING PROCESS
PROCESS VERSION/DATE    MRPAYPLN A.8     4-MAR-1982 16:22:53.21
          PROCESS OPTIONS AND PARAMETERS
   SPACECRAFT ID                    SC_ID      = 4
   START ORBIT                      F_ORBIT    = 05482
   STOP ORBIT                       L_ORBIT    = 06152

   DISPLAY DETAIL OPTION            D_DETAIL   = ON
   DISPLAY PARAMS OPTION            D_PARAM    = ON
   DISPLAY INVALIDS OPTION          D_INVAL    = ON
   DISPLAY ERRORS OPTION            D_ERROR    = OFF
   REPORT DETAILS OPTION            R_DETAIL   = ON
   REPORT PARAMS OPTION             R_PARAM    = ON
   REPORT INVALIDS OPTION           R_INVAL    = ON
   REPORT ERRORS OPTION             R_ERROR    = ON

   DISPLAY CHK PNT FREQ             DISP_FREQ  = 10
   PROCESS CHK PNT FREQ             PROC_FREQ  = 500

ENTER VALUE(S) OR 'END' TO STOP:
```

Scheduling Display

DRNTS SCHEDULE FOR GSTDN STATIONS

DATE: 4-FEB-82
TIME:10:49
DRNT COPY

APPLICABLE PERIOD: 82:215:00:00 -82:216:00:00

	TAPE-ID	RECORDED DATA INTERVALS (Z)	SC
STATION: TGS	MT421521	215:01:15:33-215:01:28:22	4
		215:02:52:45-215:03:06:17	4
		215:13:17:25-215:13:25:37	4
		215:14:52:59-215:15:07:04	4
		215:16:31:34-215:16:42:49	4
	XT421521	215:01:15:33-215:01:28:22	4
		215:02:52:45-215:03:06:17	4
		215:13:17:25-215:13:25:37	4
		215:14:52:59-215:15:07:04	4
		215:16:31:34-215:16:42:49	4

	TAPE-ID	RECORDED DATA INTERVALS (Z)	SC
STATION: ULA	MA421521	215:01:32:03-215:01:34:38	4
		215:01:35:19-215:01:37:23	4
		215:03:08:14-215:03:12:52	4
		215:03:13:26-215:03:15:12	4
		215:04:42:43-215:04:52:59	4
		215:06:20:29-215:06:30:55	4

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Scheduling Display

FOREIGN GROUND STATION SCHEDULE

DATE: 4-FEB-82
TIME: 10:49
DRRT COPY

[STANDARD TTY HEADER]

FOLLOWING IS THE LANDSAT DATA SCHEDULED FOR YOUR STATION:
STATION: ASA
MISSION: 4
APPLICABLE PERIOD: 82:215:00:00 - 82:216:00:00

ORBIT	DAY	NASA RECORDER TIMES	EXPECTED TAPE ID
05422	215	00:20:19-00:34:23	MU421521
05423	215	02:01:41-02:09:05	MU421521
05429	215	12:29:09-12:42:58	MU421521
05430	215	14:08:01-14:18:37	MU421521
05436	215	23:26:30-23:38:51	MU421521

COMMENTS:

Control Center Operations

- Overview
- Operator Interfaces
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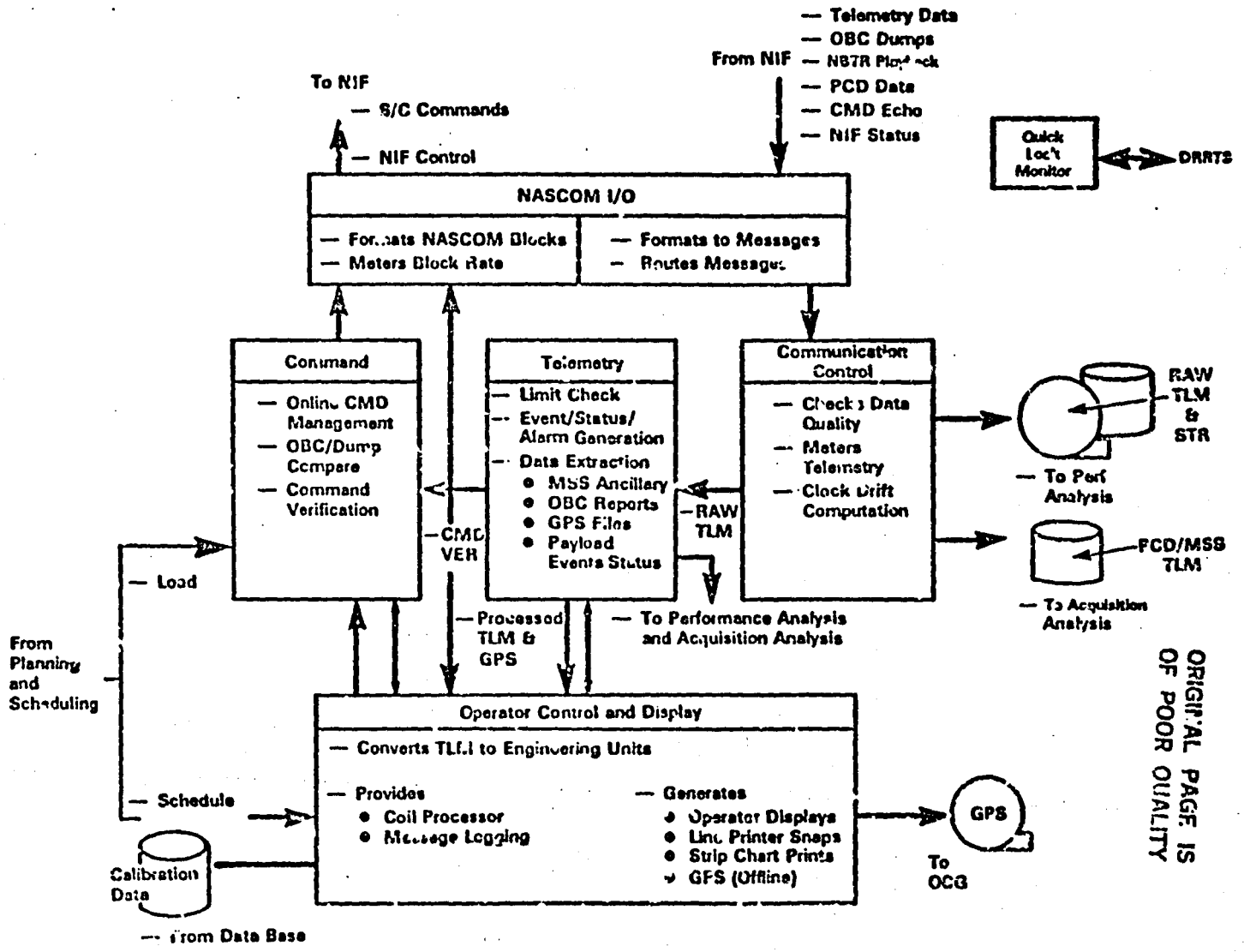
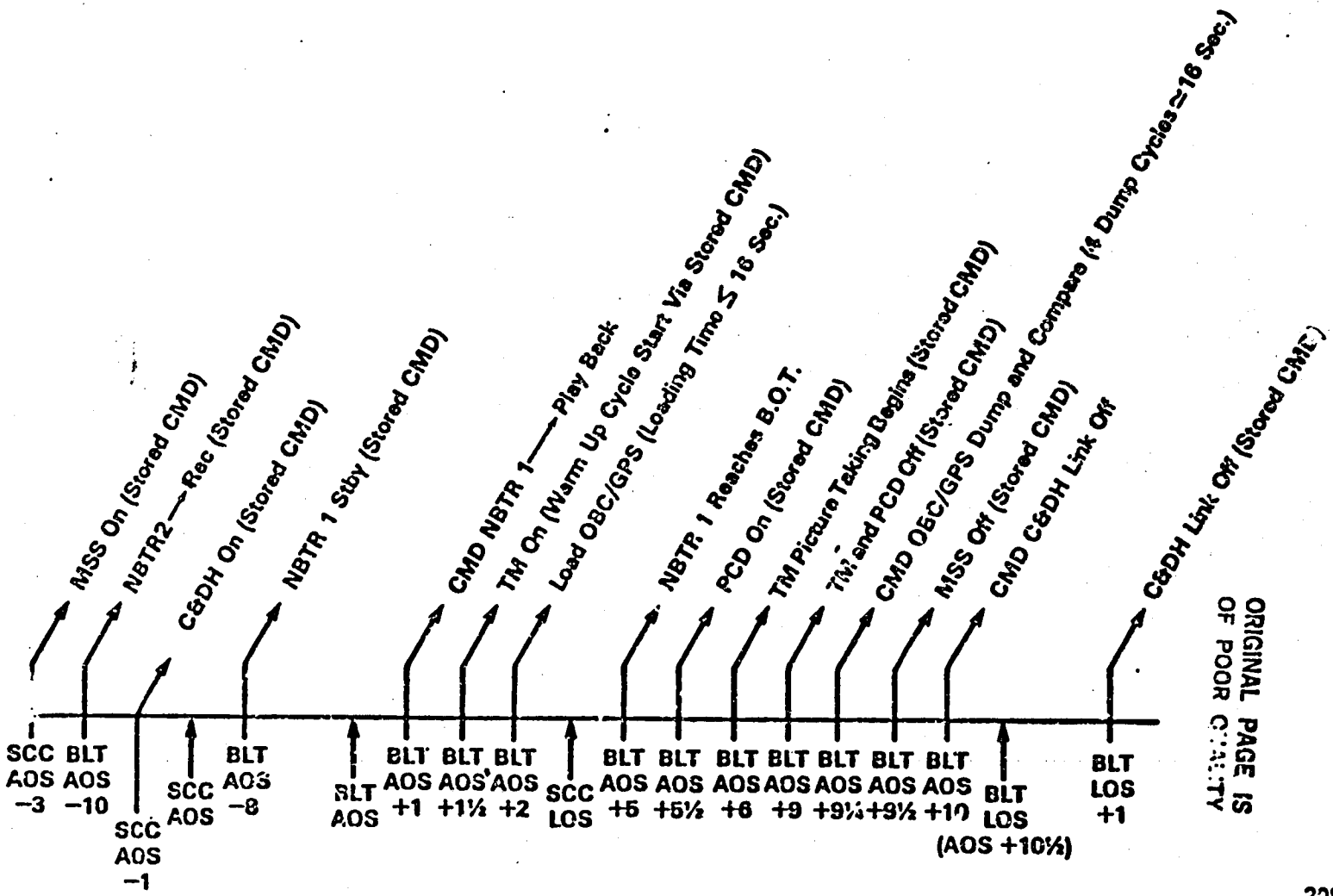
On-Line Activity Flow



On Line Resource Requirements

- Requires Flight Controller
  - Ground Controller
  - Multi-Mission Spacecraft Evaluator
  - Instrument Module Evaluator
- Uses Two VAX's ~20 Passes (~10 Hours Each VAX)
  - Switching Unit
  - OPS Consoles
  - Strip Charts

Typical FGS-GSTDN Timeline
(Flight Segment)



Typical FGS-GSTDN Timeline (Ground Segment)

Pre Pass ~15 Minutes

- Configure HW and SW
- Establish Communications
- Flow Simulator TLM From GSTDN
- Flow Commands to GSTDN
- Configure for Pass

Pass ~10 Minutes

- Verify TLM Processing and S/C Status
- Test Command Link (TIC/TOC)
- Real Time Commands as Required
- Monitor S/C Events

Post Pass ~5 Minutes

- Terminate Real Time Processes
- Wrap Up and Print Logs
- Wrap Up Files
- Predict S/C Status

Sample List of COIL Directives

DISPLAY DIRECTIVES

*1.	PAGE	PAGE NAME, UPDATE RATE
*2.	SNAP	PAGE NAME
3.	CHART	SWITCH, TABLE, RECORDER
4.	RAWDUMP	DEVICE, MINOR FRAME RATE, MNEMONICS
5.	LIST	FILE, FORMAT, LOGICAL RECORD NUMBER
6.	MSGSELECT	MESSAGE TYPE
7.	CLEAR	REGION
8.	LOCAL	
9.	MSGSELECT	MESSAGE TYPE
10.	FORMAT	PAGE NAME, PAGE NUMBER, UPDATE RATE

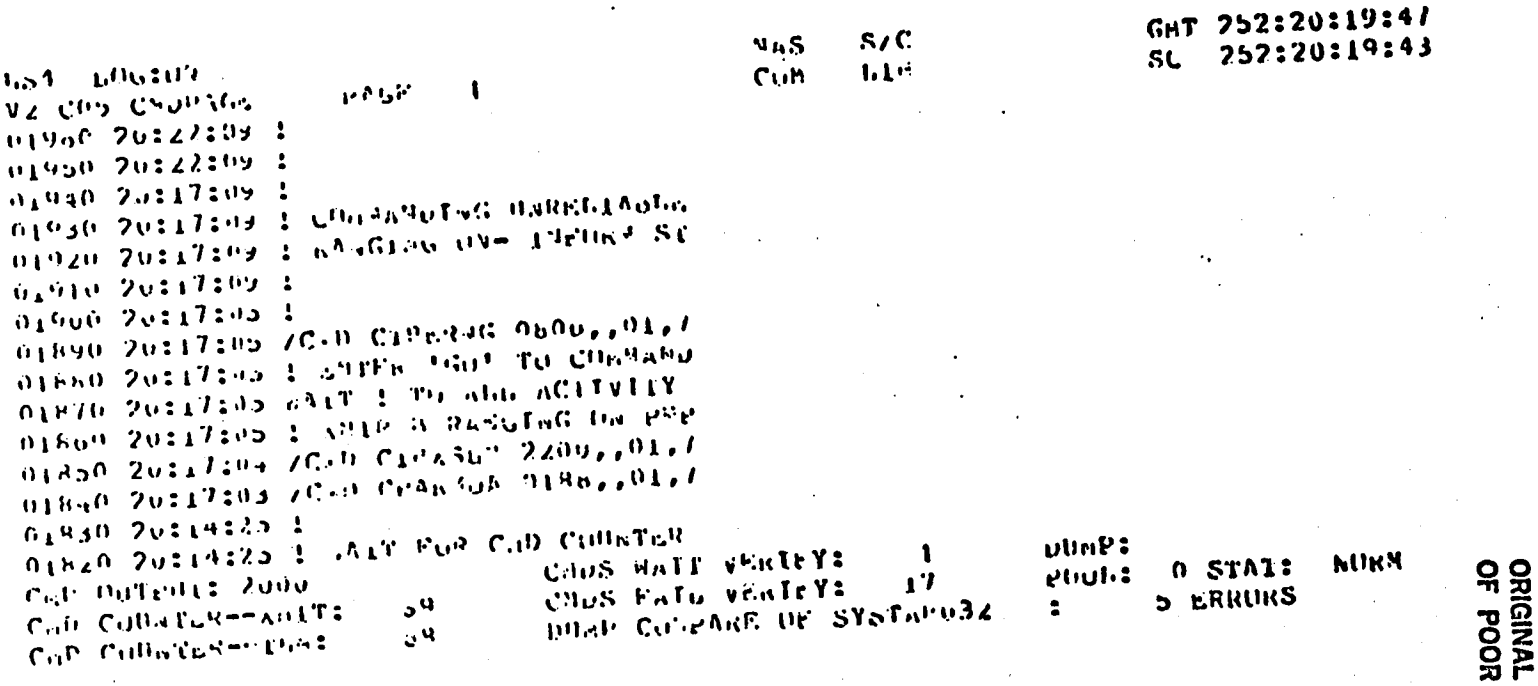
COMMAND DIRECTIVES

*1.	/CMD	MNEMONIC, MAGNITUDE, RIU
2.	/SELECT	OPTION, ARG 1, ARG 2
3.	/CLEAR	
4.	/ALLOW	
5.	/SEND	
6.	/RETRY	
7.	/HOLD	MNEMONIC
8.	/RESUME	MNEMONIC
9.	/CONFIRM	TARGET
10.	/CANCEL	
11.	/OBC	LOAD, TYPE, SOURCE
12.	COMPARE	TARGET, FILENAME
13.	EDIT	FILE, MODE, VALIDATE
14.	LOADCNV	SOURCE, UPLINK
15.	COMPILER	
16.	/SPC	LOAD, ABS, SOURCE
17.	GCM	MNEMONIC

*EXAMPLE PROVIDED

NOTE: DIRECTIVES PRECEDED BY A "/" CAN ONLY BE ENTERED FROM THE COMMAND CONSOLE

On Line Display—Command



On Line Display—SUCONFIG

```
LS4                                                          GMT 085:03:40:15
V2 C03 SUCONFIG     PAGE   1                                 SC  252:13:06:27
                          NASCOM SWITCHING UNIT STATUS

NAS   VAX1     VAX2     VAX3     NAS   VAX1     VAX2     VAX3        PERIPHERAL
IN    ACHAN    ACHAN    ACHAN    OUT   ACHAN    ACHAN    ACHAN         STATUS

     1 2 3 4  1 2 3 4  1 2 3 4       1 2 3 4  1 2 3 4  1 2 3 4
   1 .     .  C                   1 .     .  .
   2 .     .                      2 .     .
   3   .      C     .             3   .        .     .
   4   .                          4   .                    C
   5     .        C   .            5     .        C   .
   6     .            .   .        6     .            .   .
   7                C             7                  C
   8                    .   .      8                      C   .

                                                  DRUMPEN PLOTTER-VAX2
                                                  GMT SOURCE-1
                                                  HOST COMPUTER-VAX2
                                                  AUTO/MANUAL-AUTO

                                                            DS1-OPR
                                                  DISPLAY   DS2-OPR
                                                  STATIONS  DS3-PLY
                                                            DS4-OPR

THIS PAGE SHOWS THE SWITCHING UNIT   CRT01-VAX3 CRT04-VAX1 CRT07-VAX3 CRT09-VAX2
STATUS.  SEE PAGE 2 FOR THE DEFINED  CRT02-VAX2 CRT05-VAX1 CRT08-VAX2 CRT10-VAX3
(DESIRED) CONFIGURATION.             CRT03-VAX3 CRT06-VAX1

&
```

On Line Display—Alarms

```
LS4                                                                  GMT 085:03:42:44
V2 C03 ALARMS        PAGE   1                                        SC  252:13:06:27
252:12:05:22 03922 OPT BENCH TEMP LO     EVALUATE IRU ASSY
   03162          37                 0                0                    0
252:11:57:27 09935 MSS SHUTTER OFF       EVALUATE - CMD ON
   09002           1                 0                0                    0
252:11:57:27 05990 RIU 4 A OFF           EVALUATE CMD ON
   05056           0                 0                0                    0
252:11:57:27 05962 SET2 PYROS ARM        EVAL CMD SAFE MODE
   05017           1                 0                0                    0
252:11:57:27 05960 SET1 PYROS ARM        EVAL CMD SAFE MODE
   05045           1                 0                0                    0
252:11:57:27 03920 OPT BENCH TMP LO      EVALUATE FHST ASSY
   03151          37                 0                0                    0
252:11:57:27 03903 SKEW WHL TEMP         EVAL- CALL MACS ENGINEER
   03136           1  03150          98                0                    0
252:11:57:27 03902 YAW WHL TEMP          EVAL- CALL MACS ENGINEER
   03135           1  03149          98                0                    0
252:11:57:27 03901 PTCH WHL TEMP         EVAL- CALL MACS ENGINEER
   03134           1  03148          98                0                    0

&
```

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On Line Display—Limits

```
LS4
V2 COJ LIMITS          PAGE   1
252:12:05:55 03156 ABPWRCDT
 PAIR=1      47.618/     2.954
252:12:05:22 03156 ABPWRCDT
 PAIR=1      47.618/     2.954
252:11:57:59 03156 ABPWRCDT
 PAIR=1      47.618/     2.954
252:11:57:59 03153 AFSSTHP
 PAIR=1      44.262/     2.954
252:11:57:27 03162 ATRUUBTP
 PAIR=1      45.183/     9.594
252:11:55:16 03153 AFSSTHP
 PAIR=1      44.262/     2.954
052:15:33:43 03162 AIRUUBTP
 PAIR=1      45.183/     9.594
052:15:33:43 0315o ABPWRCDT
 PAIR=1      47.618/     2.954
253:05:25:58 03162 AIRUUBTP
 PAIR=1      45.183/     9.594

&
```

```
                                                GMT 085:03:42:04
                                                SC  252:13:06:27
H     50.277                  11
33/          150
IH HJ=    28                  50
33/          150                 59      28    1      42.970
H     50.983                  22
33/          150
IL HJ=    11                 150
40/          150                 31      11    1      -4.863
H     48.220                  36
40/          119
L     -3.939                 167
40/          150
IH HJ=    21                  52,
40/          119                 21      21    1      84.410
IH HJ=    21                  94
33/          150                 21      21    1      42.970
H     52.265                  31
40/          119
```

On Line Display—MPS

```
LS4                                                          GMT 085:03:55:20
V2 C03 MMPS          PAGE    1                               SC  252:13:06:27
MPS BATTERY STATUS (5)

V BATTERY 1    30.72  VOLT   V BATTERY 2    30.72  VOLT   V BATTERY 3    30.72  VOLT
I BTRY 1 HIGH   5.20  AMPS   I BTRY 2 HIGH   5.20  AMPS   I BTRY 3 HIGH   5.20  AMPS
I BTRY 1 LOW    3.00  AMPS   I BTRY 2 LOW    3.00  AMPS   I BTRY 3 LOW    3.00  AMPS
T BTRY 1 P     11.70  C      T BTRY 2 P     11.70  C      T BTRY 3 P     11.39  C
T BTRY 1 R     11.70  C      T BTRY 2 R     11.70  C      T BTRY 3 R     11.70  C
V 3RD ELECT 1     39  MV     V 3RD ELECT 2     39  MV     V 3RD ELECT 3     39  MV
V DELTA 1        176  MV     V DELTA 2        176  MV     V DELTA 3        176  MV

PD BTRY 1          CLS      PD BTRY 2          CLS      PD BTRY 3          CLS
BTRY 1 CHARGER      ON      BTRY 2 CHARGER      ON      BTRY 3 CHARGER      ON
BTRY 1 TEMP        NOR      BTRY 2 TEMP        NOR      BTRY 3 TEMP        NOR

&
```

On Line Display—PDU

```
LS4                                                    GMT 085:03:57:42
V2 C03 PPDU          PAGE   1                          SC  252:13:06:27
PDU PWR DISTRB & ANALG
 PAYLOADS
  TM PWR A       DIS       TM PWR B       DIS
  MSS PWR A      ENA       MSS PWR B      DIS
  DASB PWR A     DIS       DASB PWR B     DIS
  GPS PWR        ENA       DTJ PWR         ON
  F/ADSA PWR A   ON        DPU SEL          A
        TM FUSIBLE LINKS PWR   DIS
 HEATERS
  USS 3C BUS       A       MSS I/F B      ENA
  USS 3A         ENA       TM EXT STDBY   ENA
  USS 3B         DIS       TM SHA         ENA
  USS 3C         DIS       HINGE           ON

 SPARE RELAYS              RIU
  TICK TOCK      TOC       PDU ELEC SEL     A
  SPARE 2        OFF       PDU A RIU A      A
  SPARE 2 BUS      A       PDU B RIU A      B

&
```

```
 ANALOG
  +5V SUPPLY        6.13   VOLTS
  LOGIC TEMP       21.62   DEG C
  PS TEMP          21.54   DEG C

  SEGMENTED SW 1       1   180 DEG
  SA POSITION1       122   COUNTS
  SA POSITION1     87.63   DEG

  SEGMENTED SW 2       1   180 DEG
  SA POSITION2       122   COUNTS
  SA POSITION2     87.63   DEG

  TM 18V/20V        5.10   VOLTS
```

On Line Display—PDU

```
LS4                                                          GMT 085:03:58:07
V2 C03 PPDU          PAGE   2                                SC  252:13:06:27
PDU TELEMETRY DUMP (3)
    LOADS            HEATERS              MOTORS                    SAD
TH A          DIS  TH SMA       ENA  MTR DR A     ENA          MODE        FWD
TH B          DIS  TH EXT SBY   ENA  MTR DR B     ENA          INH LOGIC DIS
MSS A         ENA  MSS I/F B    ENA  SA DPLY SEL  YES          RATE         1W
MSS B         DIS  USS 3A       ENA  LH SEL       NO           CONTROLLIN NO
DASB A        DIS  USS 3B       DIS  UH SEL       NO       - - - - SAFEHOLD - - - -
DASB B        DIS  USS 3C       DIS  DPLY INH LOGIC DIS                  A       B
GPS           ENA  USS 3C BUS     A  SA/LH RETRACT  ALL    STATUS      ENA     DIS
DPU            ON  HINGE         ON  DPLY DIRECTION FWD    MODE        END     INH
F/ADS          ON                     DPLY DRIVING   DRV    MACS SIG     NO      NO
TH 18/20V     5.10  VOLTS             SA DEPLOYED    DPL    ACTIVATE    ENA     DIS
TH FS LINK DIS                       LH DEPLOYED     NO     CONTROLLING NOT     YES
PDU ELECT      A                     UH DEPLOYED     NO     AT INDEX POS YES    YES
PDU A BIU A    A                                            CSS SAD RATE STP    STP
PDU B BIU A    B
   SERIAL WORD      (1)          (2)          (3)          (4)
   BILEVEL WORDS   601        8 602       221 603       242 604       248

&
```

On Line Display—Wide Band

LS4 GMT 085:03:59:10
V2 C03 PHB PAGE 2 SC 252:13:06:27

WIDE BAND TEMPERATURES

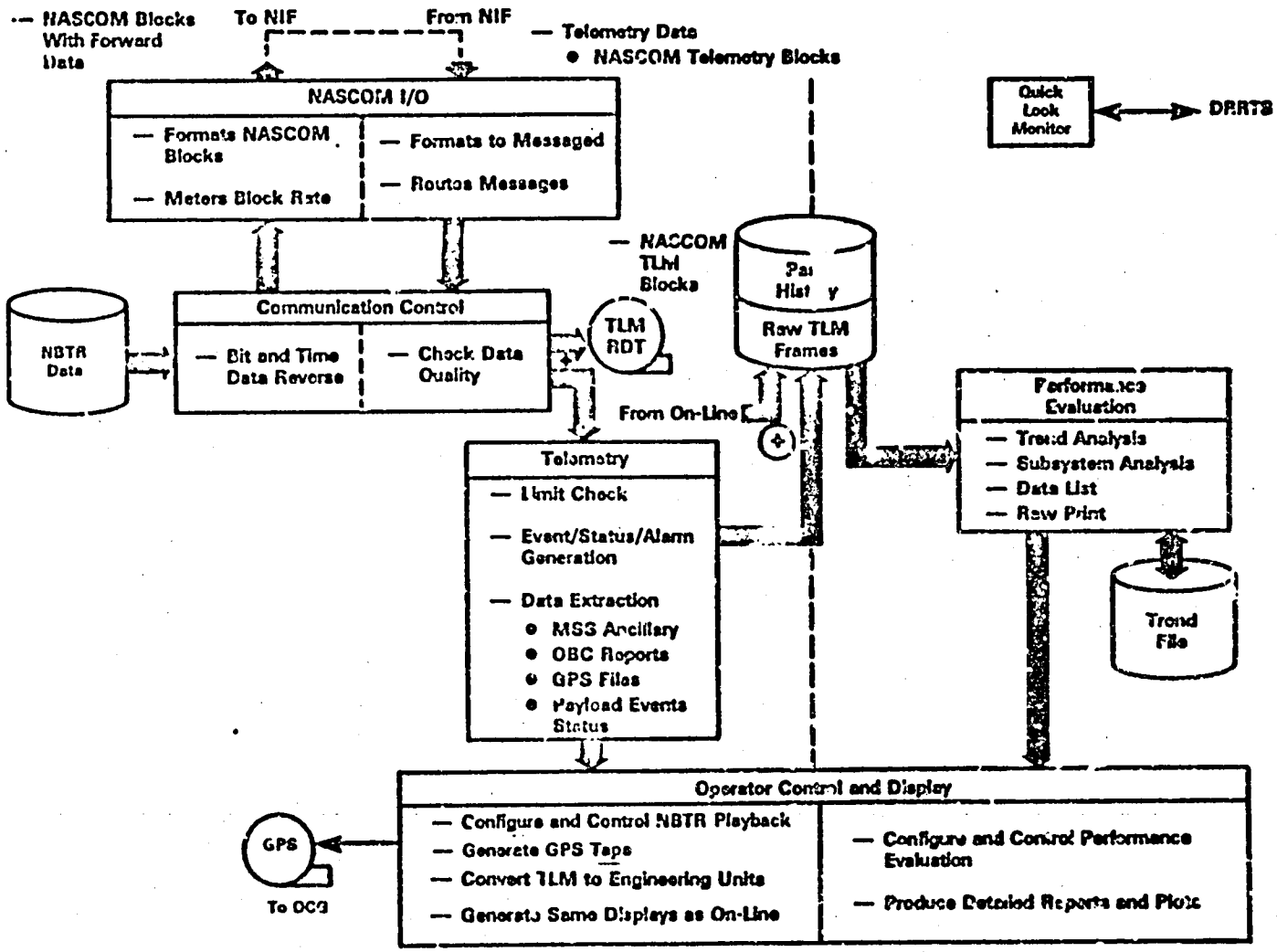
	RFC TEMPERATURES				WBM TEMPERATURES		
WATFEEDT	AUTOTRK COMB ASY	24	C	WPXCOVT	+X COVER	25	C
WATFST	AUTOTRK FREQ SRC	24	C	WPSUPYT	+Y PANEL(PSU)	25	C
WGDAHT1	GDA MOUNT	24	C	WPZPNLT	+Z PANEL	25	C
WKUDIP1	KU DIPLEXER	24	C	WPSUMXT	-X PANEL(PCU)	25	C
WKUPCONT	KU UPCONVERT	24	C	WGDET	GIM DRV ELECT	23	C
WKUNCONT	KU DWNCONVERT	00	C	WATRCVRT	AUTOTRK RCVR	24	C
WKTWTAT	KU-TWTA SIDE	23	C	WTWTSIDT	X-TWTA SIDE	28	C
WRKTWTBT	KU-TWTA BASEPL RED	23	C	WPXTWTAT	X-TWTA BASEPL PRI	28	C
WPKTWTBT	KU-TWTA BASEPL PRI	24	C	WRXTWTAT	X-TWTA BASEPL RED	28	C
WURFEEDT	FEED PNL	24	C	WXFST	X-BAND FREQ SRC	24	C
	GDA TEMPS			WKFST	KU FREQ SRC(DSU)	23	C
WRELMOTT	EL MTR RED	24	C	WPSKMODT	UQPSK MODULATOR	24	C
WPELMOTT	EL MTR PRI	24	C		RIU TEMPS		
WRAZMOTT	AZ MTR RED	24	C	WR1U9AT	RIU 09A TEMP	56	C
WPAZMOTT	AZ MTR PRI	24	C	WR1U9BT	RIU 09B TEMP	58	C

6

Control Center Operations

- Overview
- Operator Interfaces
- Planning and Scheduling
- On-Line
- → Performance Analysis
- Acquisition Analysis
- Test and Simulation
- Early Orbit and Contingency
- TGS

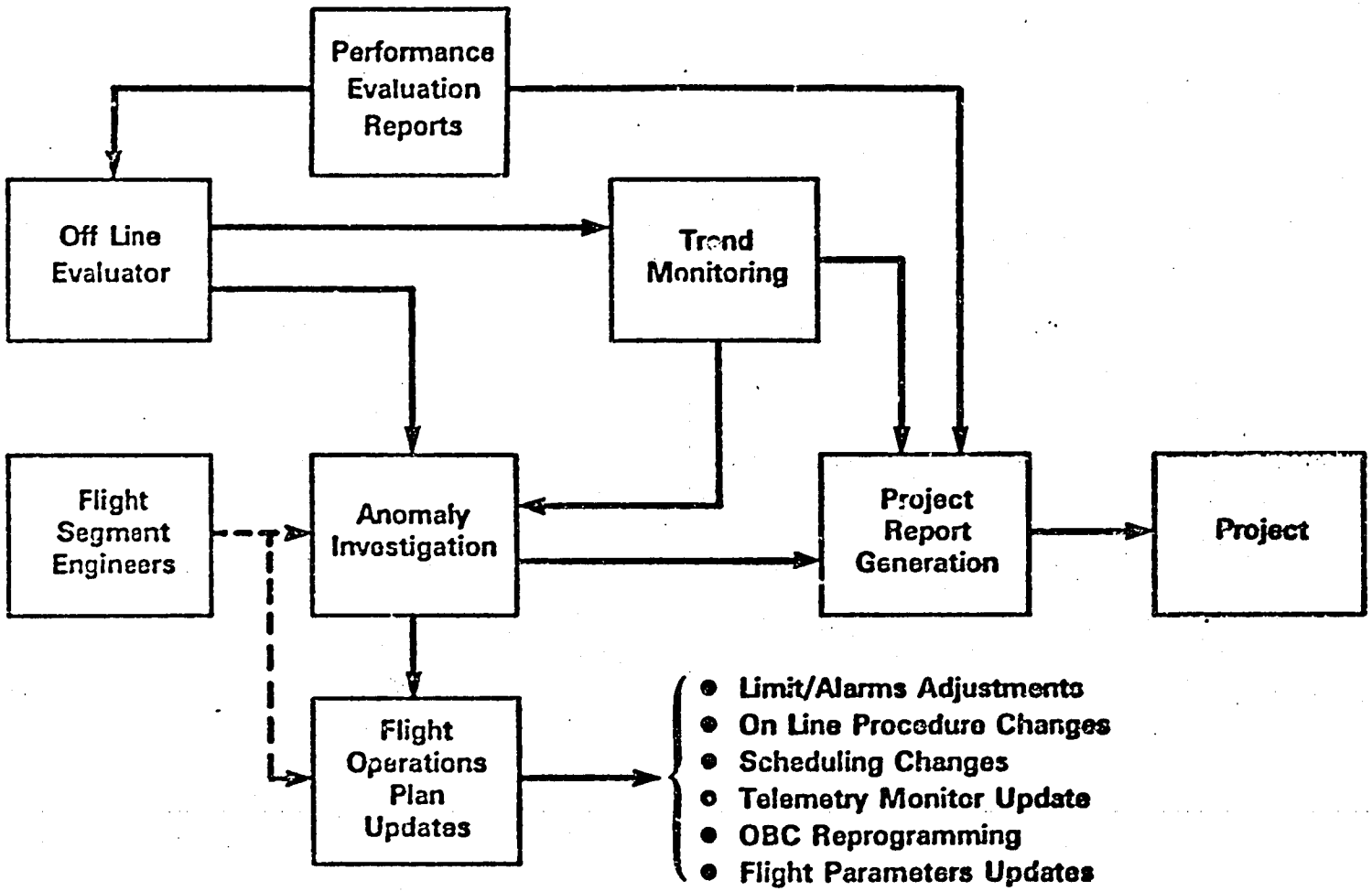
Performance Analysis Activity Flow



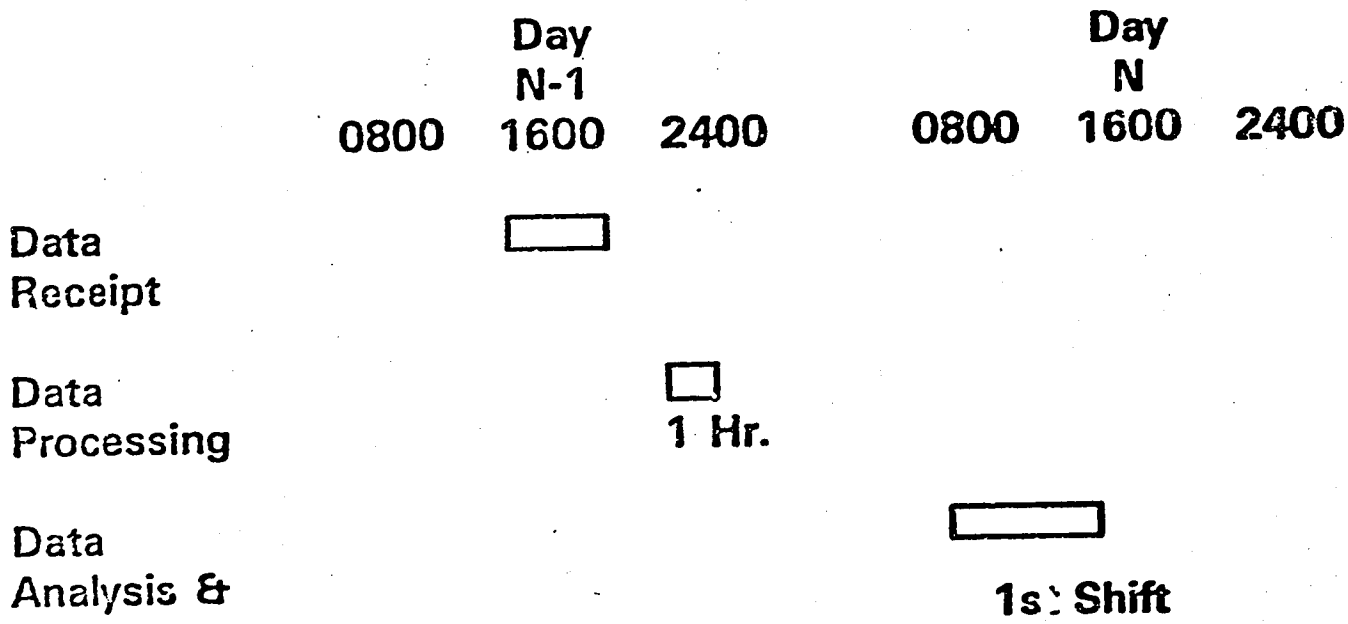
Performance Evalauation Resource Requirements

- Requires Off Line Engineering (5)
- Run In Depth Analysis (1 ORB/Day)
  - Statistics
  - Power Analysis
  - Plots
  - Reports
- Uses One VAX ~ 1 Hour for PES
- Uses One VAX ~ 8 Hours for Bit and Time Data Reverse
- Uses Quick Look Monitor

Analysis/Report Flow



Performance Evaluation Timeline



PES Report

TELEMETRY MATRIX CALIBRATED FUNCTIONS

SPACE CRAFT ID: 4

START ORBIT NUMBER: 5756 START TIME 82:253:01:51:00

END ORBIT NUMBER: 5757 END TIME 82:253:03:54:00

TIME DDD:HH:MM:SS	MAJOR FRAME AND MINOR	PYLB VOLTS 26/ 97 FRAME 4063	PY3RCE1 MVOLTS 28/ 97 4064	PY3RDE2 MVOLTS 29/ 97 4065	PISA1 AMPS 52/ 97 4074	PISA2 AMPS 52/ 98 4075	PYSA VOLTS 52/ 96 4076	PTDAT3P DEG C 38/ 98 4091	PY3RDE3 MVOLTS 30/ 97 4096
253:02:26:21	182/ 48						76.00		
253:02:26:21	182/112						75.50		
253:02:26:37	184/ 32							7.138	
253:02:26:37	184/ 48						74.50		
253:02:26:37	184/112						74.00		
253:02:26:53	186/ 48						73.50		
253:02:26:53	186/112						73.00		
253:02:27:10	188/ 32							7.439	
253:02:27:10	188/ 48						72.00		
253:02:27:10	188/112						71.50		
253:02:27:26	190/ 48						71.00		
253:02:27:26	190/112					12.95	70.00		
253:02:27:43	192/ 32							7.724	
253:02:27:43	192/ 48						69.50		
253:02:27:43	192/112						69.00		
253:02:27:59	194/ 32							8.029	
253:02:27:59	194/ 48						68.50		
253:02:27:59	194/112						67.50		
253:02:28:12	196/ 48						67.00		
253:02:28:12	196/112						66.50		
253:02:28:28	198/ 32							8.317	
253:02:28:28	198/ 48						65.50		
253:02:28:28	198/112						65.00		
253:02:28:46	191/ 48						64.50		
253:02:28:46	191/112				13.00		64.00		
253:02:29:04	193/ 32							8.616	
253:02:29:04	193/ 48						63.00		
253:02:29:04	193/112						62.50		

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PES Report

STATISTICAL EVALUATION REPORT

SPACECRAFT ID: 6

START ORBIT NUMBER: 5756 START TIME: 82:253:01:51:00
END ORBIT NUMBER: 5757 END TIME: 82:253:03:36:00

ORBIT NUMBER: 5757

FUNCTION NUMBER	FUNCTION ACRONYM	FUNCTION UNIT	SUBSYSTEM ACRONYM	EVENT	MODE	LOGIC	NUMBER SAMPLES	MEAN VALUE	MIN VALUE	MAX VALUE	STANDARD DEVIATION
20004	PWR AMP TEMP 1-4	DEG C					738	22.26	7.72	29.90	7.65
20005	SES NAI VLT	VOLTS					591	31.83	29.24	32.48	0.74
20006	SES IMP ELEC VLT	VOLTS					591	68.40	56.00	78.80	10.91
20007	TOTAL LOAD CUR	AMPS					9999	23.99	21.80	28.80	3.41
20008	S/C STRUCTURE TP	DEG C					1182	15.56	4.27	21.44	6.09
20009	MIG 4 TEMP	DEG C					394	18.83	4.33	26.66	6.69
20010	SCECU 5V POWER	VOLTS					394	2.50	0.00	5.00	2.50
20011	SCECU 25V POWER	VOLTS					394	12.48	0.00	24.96	12.48
20012	MEA Tem	DEG C					1576	75.79	49.39	89.43	14.08
20013	Tank Temp	DEG C					591	63.67	51.73	69.70	6.23
20014	L/V Temp	DEG C					591	63.67	51.73	69.70	6.23
20015	Beam Temp	DEG C					394	63.65	51.73	69.70	6.24
20016	SES NAI TMP PRI	DEG C		RSS SYS A PWR TM PWR A SATELLITE	ON ENA DAY	ON AND	394	63.65	51.73	69.70	6.24
20017	SES NAI VLT	DEG C		SATELLITE RSS SYS A PWR TM PWR A	DAY ON ENA	AND ON	333	18.75	17.43	19.63	0.54
20020	SCANMIRTEMP	DEG C		RSS SYS A PWR RSS SCAN MON RSS SHUTTER	ON ON-A ON-A	AND AND	0	0.00	0.00	0.00	0.00
20021	TOTAL LOAD 1	AMPS		XMTR PWR X-BAND KU BAND ON/OFF	ON-A PRI	OR ON	9999	23.99	21.80	28.80	3.41
20022	XMTR A PWR AMP T	DEG C		XMTR PWR RSS SYS A PWR	ON-A ON	AND	537	32.29	23.62	37.09	6.59

PES Report

BATTERY ANALYSIS REPORT

SPACECRAFT ID: 456

START ORBIT NUMBER: 5756 START TIME: 82:253:01:51:09
END ORBIT NUMBER: 5756 END TIME: 80:000:00:00:00

(START) TIME	ORBIT MODE	(AVERAGE) BATTERY CURRENTS 1	2	3	BYSTEM	PERCENT CHARGE 1	2	3	PERCENT LOAD 1	2	3	BATTERY VOLTS 1	2	3	BATT TEMP 1	2	3	CHG/DISCHG RATIO 1	2	3	STS
253:01:51:07	DAY	2.30	2.30	2.30	6.90	33.3	33.3	33.3	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	19.7				
253:01:51:07	ORBIT	2.30	2.30	2.30	6.90				33.3	33.3	33.3				19.6	19.6	19.7	2.0	2.0	2.0	3.0
253:01:51:07	TAPER	0.00	0.00	0.00	10.00							32.48	32.48	32.48	19.6	19.6	19.6				

																		3RD ELECTRODE VOLTS 1	2	3
ORBIT MINIMUM	-8.80	-8.80	-8.80	-26.40	33.3	33.3	33.3	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	19.6	55.0	56.0	56.0
ORBIT AVERAGE	2.30	2.30	2.30	6.90	33.3	33.3	33.3	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	19.7	72.5	72.5	72.5
ORBIT MAXIMUM	6.00	6.00	6.00	18.00	33.3	33.3	33.3	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	20.0	79.6	79.0	79.0
STD DEVIATION	6.41	6.41	6.41	19.23	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.0	0.0	0.2	9.5	9.5	9.4

253:01:51:56	NIGHT	-9.37	-9.37	-9.37	-28.11				33.3	33.3	33.3	30.85	30.85	30.85	9.5	9.5	9.4			
253:02:24:10	DAY	6.30	6.30	6.30	18.90	33.3	33.3	33.3	0.0	0.0	0.0	31.29	31.29	31.29	15.6	15.6	15.7			
253:01:51:56	ORBIT	1.22	1.22	1.22	3.66				33.3	33.3	33.3				13.6	13.6	13.7	1.4	1.4	1.4	1.4
253:01:51:07	TAPER	6.00	6.00	6.00	18.00							32.48	32.48	32.48	19.6	19.6	19.6				

																		3RD ELECTRODE VOLTS 1	2	3
ORBIT MINIMUM	-9.60	-9.60	-9.60	-28.80	33.3	33.3	33.3	33.3	33.3	33.3	29.76	29.76	29.76	5.1	5.1	5.1	56.0	56.0	56.0
ORBIT AVERAGE	1.22	1.22	1.22	3.66	33.3	33.3	33.3	33.3	33.3	33.3	31.15	31.15	31.15	13.6	13.6	13.7	70.9	70.9	70.9
ORBIT MAXIMUM	18.40	18.40	18.40	55.20	33.3	33.3	33.3	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	19.6	78.0	78.0	78.0
STD DEVIATION	7.58	7.58	7.58	22.75	0.0	0.0	0.0	0.0	0.0	0.0	0.97	0.97	0.97	4.8	4.8	4.8	10.3	10.3	10.3

253:03:30:47	NIGHT	-9.29	-9.29	-9.29	-27.87				33.3	33.3	33.3	31.20	31.20	31.20	10.9	10.8	10.8			

																		3RD ELECTRODE VOLTS 1	2	3
ORBIT MINIMUM	-9.60	-9.60	-9.60	-28.80	0.0	0.0	0.0	33.3	33.3	33.3	30.24	30.24	30.24	6.6	6.6	6.6	56.0	56.0	56.0
ORBIT AVERAGE	-9.29	-9.29	-9.29	-27.87	0.0	0.0	0.0	33.3	33.3	33.3	31.20	31.20	31.20	10.9	10.8	10.8	56.0	56.0	56.0
ORBIT MAXIMUM	-8.80	-8.80	-8.80	-26.40	0.0	0.0	0.0	33.3	33.3	33.3	32.48	32.48	32.48	19.6	19.6	20.0	56.0	56.0	56.0
STD DEVIATION	0.29	0.29	0.29	0.83	0.0	0.0	0.0	0.0	0.0	0.0	0.68	0.68	0.68	3.8	3.8	3.7	0.0	0.0	0.0

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PES Report

SOLAR ARRAY CURRENT REPORT

SPACECRAFT ID: LS4

START ORBIT NUMBER: 5756 START TIME: 82:253:01:51:00
END ORBIT NUMBER: 5756 END TIME: 80:000:00:00:00

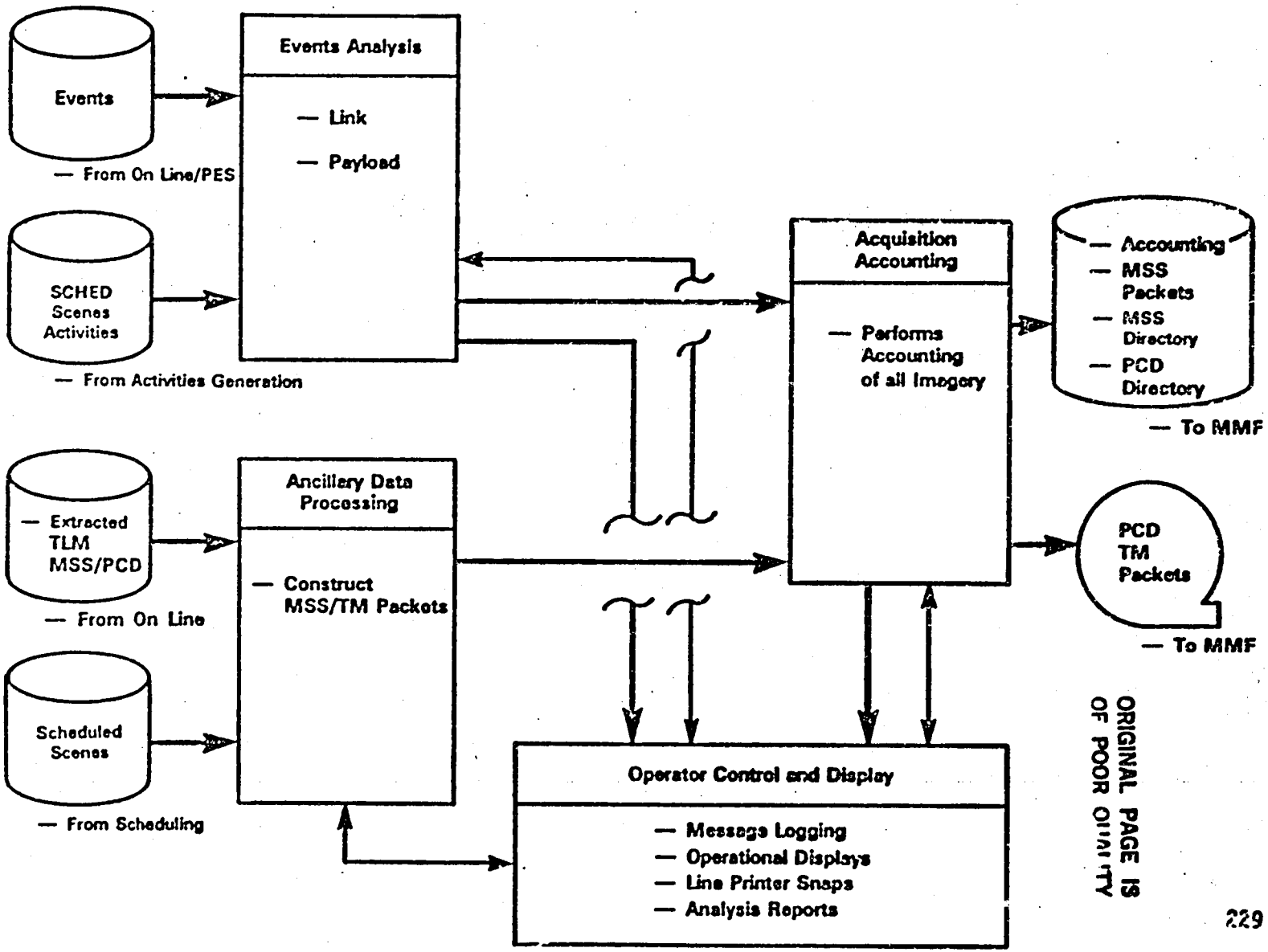
TIME	SOLAR ARRAY TEMPERATURE					SOLAR ARRAY CURRENT			ARRAY VOLTAGE	ARRAY POWER	ARRAY ENERGY	PREDICTED ARRAY	DIFFERENCE CURRENT
	1	2	3	4	AVG	1	2	TOTAL	TOTAL	WATTS	WT-MIN	CURRENT	
253:01:51:07	26.5	26.5	26.5	26.5	26.5	11.80	11.75	23.55	52.50	1236.5	329.7	0.00	23.55
253:01:51:07	26.5	26.5	26.5	26.5	26.5	11.80	11.75	23.55	52.50	1236.5	329.7	0.00	23.55
253:01:51:40	26.5	26.5	26.5	26.5	26.5	11.80	11.75	23.55	52.50	1236.5	329.7	0.00	23.55
253:01:51:40	26.5	26.5	26.5	26.5	26.5	0.00	0.00	0.00	0.00	0.0	0.0	0.00	0.00
ORBIT MINIMUM	26.5	26.5	26.5	26.5	26.5	0.00	0.00	0.00	0.00	0.0	0.0	0.00	0.00
ORBIT AVERAGE	26.5	26.5	26.5	26.5	26.5	8.85	8.81	17.66	39.36	927.4	247.3	0.00	17.66
ORBIT MAXIMUM	26.5	26.5	26.5	26.5	26.5	11.80	11.75	23.55	52.50	1236.5	329.7	0.00	23.55
STD DEVIATION	0.0	0.0	0.0	0.0	0.0	5.11	5.09	10.20	22.73	535.4	142.6	0.00	10.20

AVERAGE TRACKING ERROR: 0.00 AT:

Control Center Operations

- Overview
- Operator Interfaces
- Planning and Scheduling
- On-Line
- Performance Analysis
- → Acquisition Analysis
- Test and Simulation
- Early Orbit and Contingency
- TGS

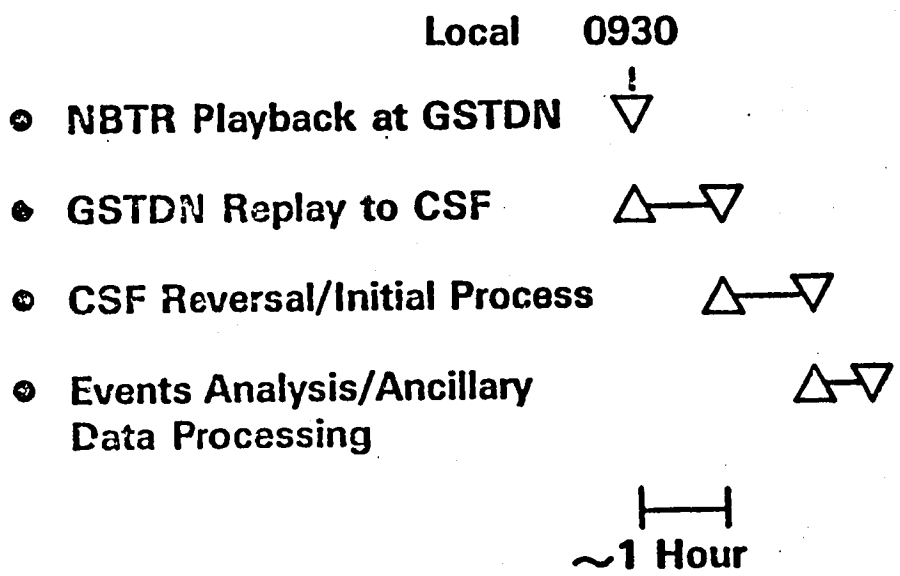
Acquisition Analysis Activity Flow



Acquisition Analysis Resource Requirements

- Requires Ground Controller
- Run Following Each NBTR Playback
- Uses One VAX ~15 Minutes Per Playback

Acquisition Analysis Timeline



- 13 - 14 NBTR Playbacks Per Day
- Average Elapsed Time 2½ Hours From NBTR Playback to End of Processing

Acquisition Analysis Report—Events Analysis

PAYFILE.RPT:2 7-FEB-1982 21:04:51.52 Page 1

****
PAYLOAD EVENTS ANALYSIS REPORT
****

1. DATE OF RUN	= 7-FEB-82
2. TIME OF RUN	= 21:00:24
3. VERSION NUMBER	= L2 MQEVENTS
4. SPACECRAFT ID	= 4
5. AVAILABLE TIME SPAN :	
5.1 STARTING TIME	= 82:215:01:12:26.0
5.2 ENDING TIME	= 82:215:01:16:45.0
6. DESIRED ANALYSIS TIME SPAN :	
6.1 STARTING TIME	= 82:215:01:00:00.0
6.2 ENDING TIME	= 82:215:02:00:00.0
7. NAME OF EVENTS FILE	= EVENT:EVN215.LOG
8. NAME OF ACTIVITY FILE	= EVENT:ACT215.ACT
9. NAME OF OUTPUT REPORT FILE	= EVENT:PAYFILE.RPT

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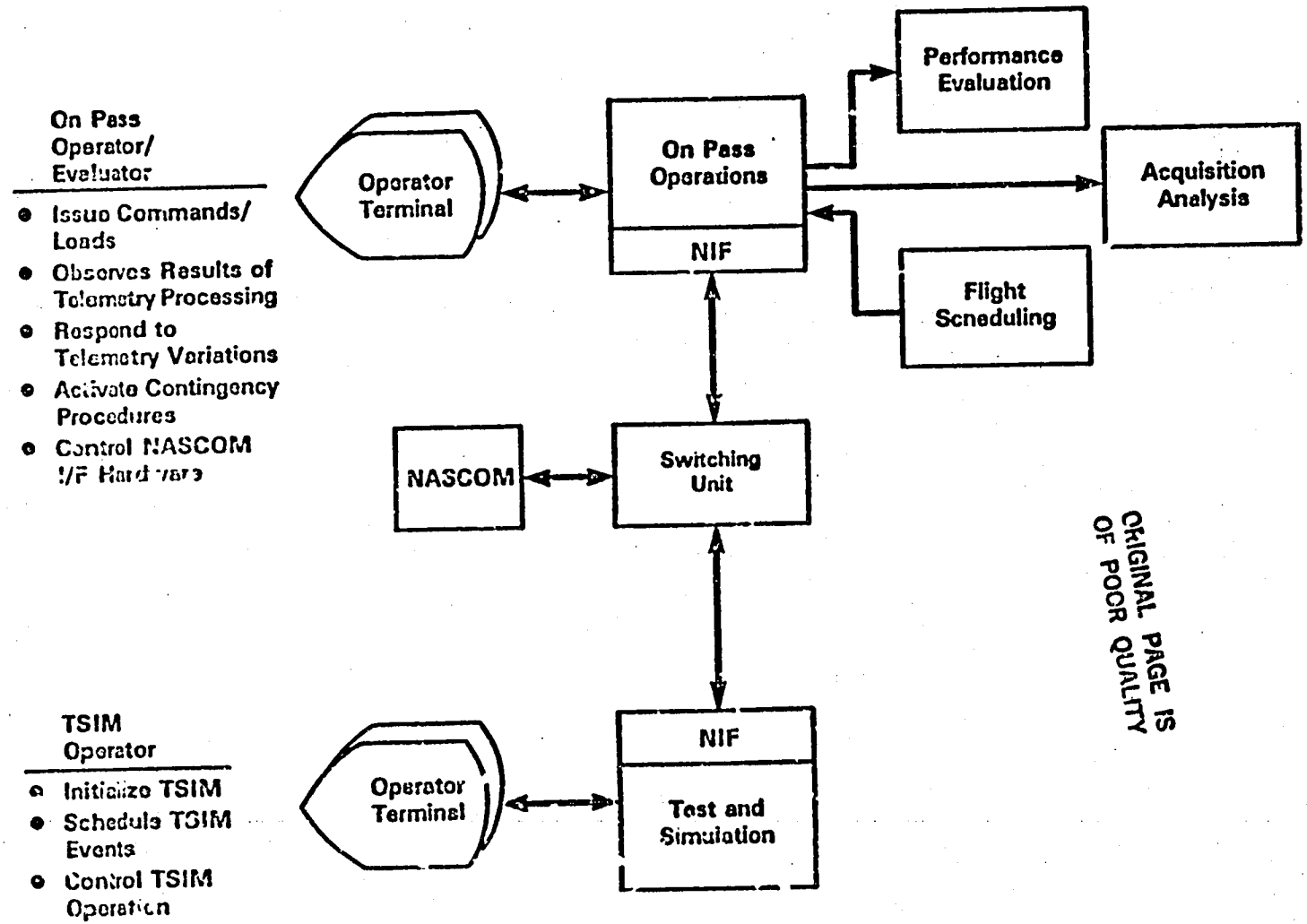
Training/Self Test/Simulations



TSIM Resource Requirements

- Flight Segment Systems Engineer
- Flight Segment Software Analyst
- Run as Required to Support
  - OBC Reprogramming
  - Software Testing
  - Simulations
  - Training
- One VAX/CDHS for Reprogramming. Second VAX Required for Flight OPS Testing

TSIM SNAP

```
                                                                    **SNAP=1981 12:31:19.58
* TIME 00-SEP-1981 11:59:00.0                                      AR(1)=-7**2.57333
* OPTIONS ON=SNAP=(ABO 11:59:00.0 IRAS4 TSAR PMS                   AR(2)=2272.2222
* SET SNAP=1,F,9 1/=)                                              AR(3)=-0.50.0333
* (C)                                                              AR(4)=237.05562
* CREATE SCAS                                                      AR(1,1)=53953850.
* CREATE PMAS                                                      AR1A(1)=-50.050745
* CREATE TSAC                                                      AR1A(2)=237.15562
* CALL                                                             AR1A(3)=237.85562
* CREATE DAY 2.                                                    AR1SA**(2)=0.00000000E+00
* WAIT 10                                                          AR1SA**(1)=0.00000000E+00
* SET TRACE=2                                                      ASCAN**(1)=24
* CALL 1                                                           ASCAN**(35)=3C
*! SET ACCOUNT=1 / 00-SEP-1981 12:10:00.0                         AR**SA**(24)=11.5165Q2
                                                                   AR**SA**(2)=1.1712052
                                                                   TSCAN**(101)=22
                                                                   ASCAN**(121)=1
                                                                   AR1ACS**(23)=-23.277619
                                                                   AR1ACSA**(24)=14.757172
                                                                   AR1SA**(3)=0.00000000E+00
                                                                   AR1SA**(4)=1.0000000E+00
                                                                   AR1SA**(51)=7?

>SNAP TASK 51 10-SEP-1981 20:5?:34.5? <
TASK=CPU-S-(AV CPU_TIME)          -31          0 SCAS ONT  PMAS 0 TL =
```

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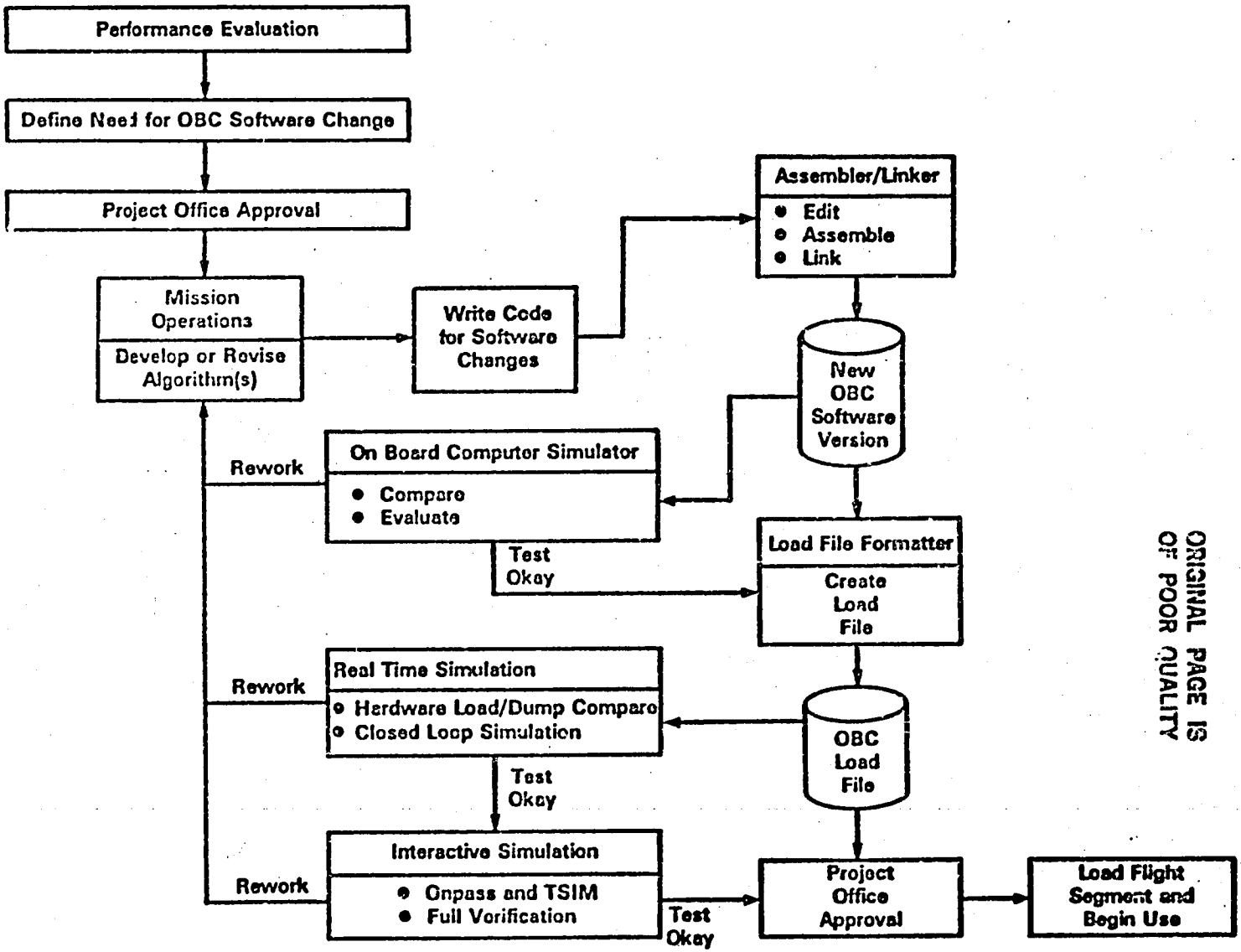
OF POOR QUALITY

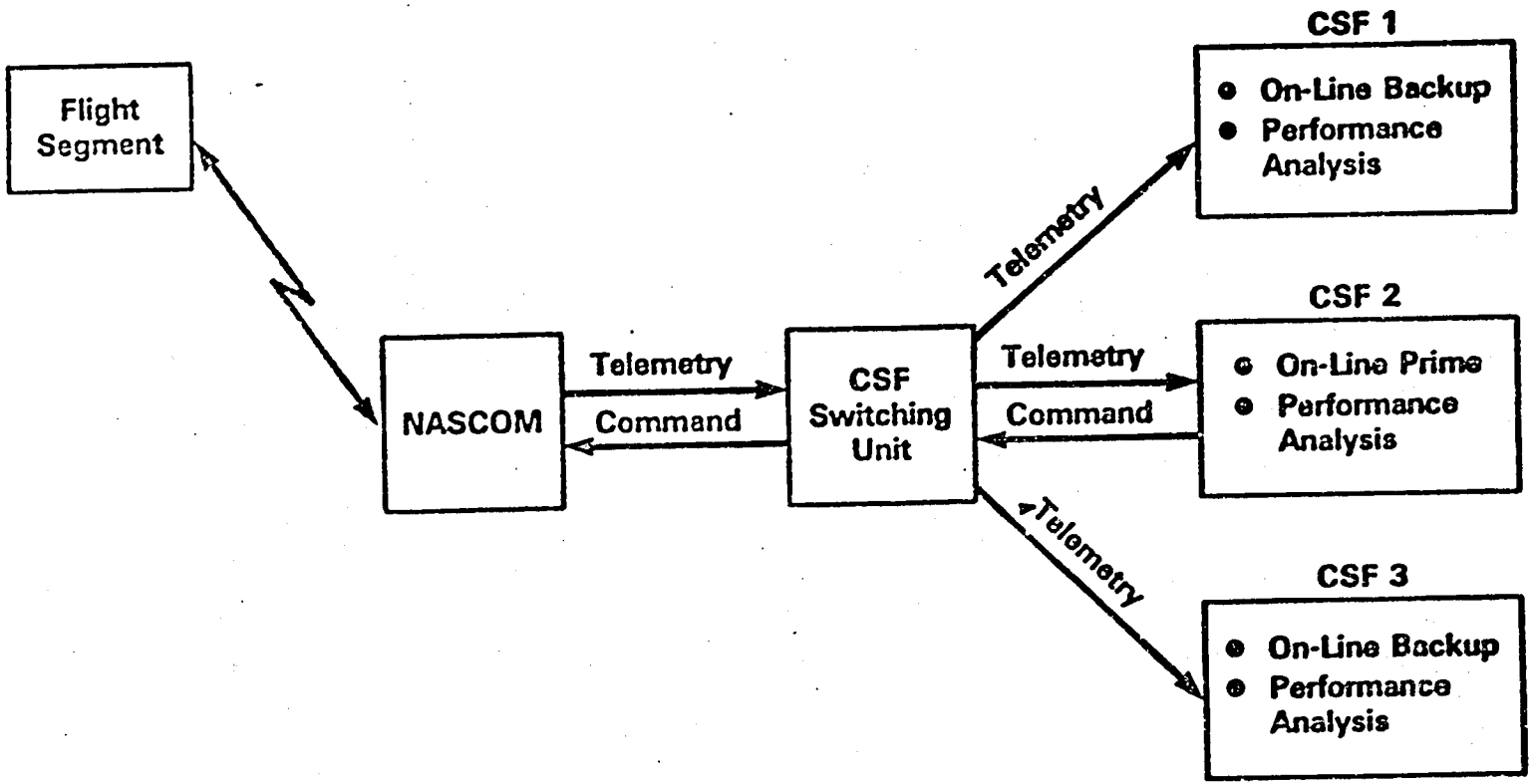
OBC Reprogramming Flow



Control Center Operations

- Overview
- Operator Interfaces
- Planning and Scheduling
- On-Line
- Performance Analysis
- Acquisition Analysis
- Test and Simulation
- → Early Orbit and Contingency
- TGS

CSF Launch Configuration



CSF Launch Support

- Valley Forge Engineering Support From Period Two Weeks Before Launch Until Four Weeks After.
- CSF to Operate With Extended Hours and Overlapping Shift Support
- Resident Core Team Support

CSF Contingency Actions

TYPICAL FAULT	ACTION
• Power Outage—Advance Warning —No Notice	— Reschedule Critical Operations — Safe the System — Restore System After Power On (10 Minutes) — Resume Operations
• Prime Computer Failure • Backup Computer Failure • Disk Drive Failure	— Switch to Hot Backup (2 Minutes) — Restore Backup — Depending Upon Timing— • Same as Failed Computer • Switch Disk From Offline VAX
• NIF A Channel • NASCOM Line Failure	— Select A Channel — Request NASCOM Reconfiguration Lines or Request GSTDN Use Alternate Address (Line)
• Switching Unit Failure	— Depends Upon Failure (Worst Case Requires Re-cabling)

Control Center Operations

- Overview
- Operator Interfaces
- Planning and Scheduling
- On-Line
- Performance Analysis
- Acquisition Analysis
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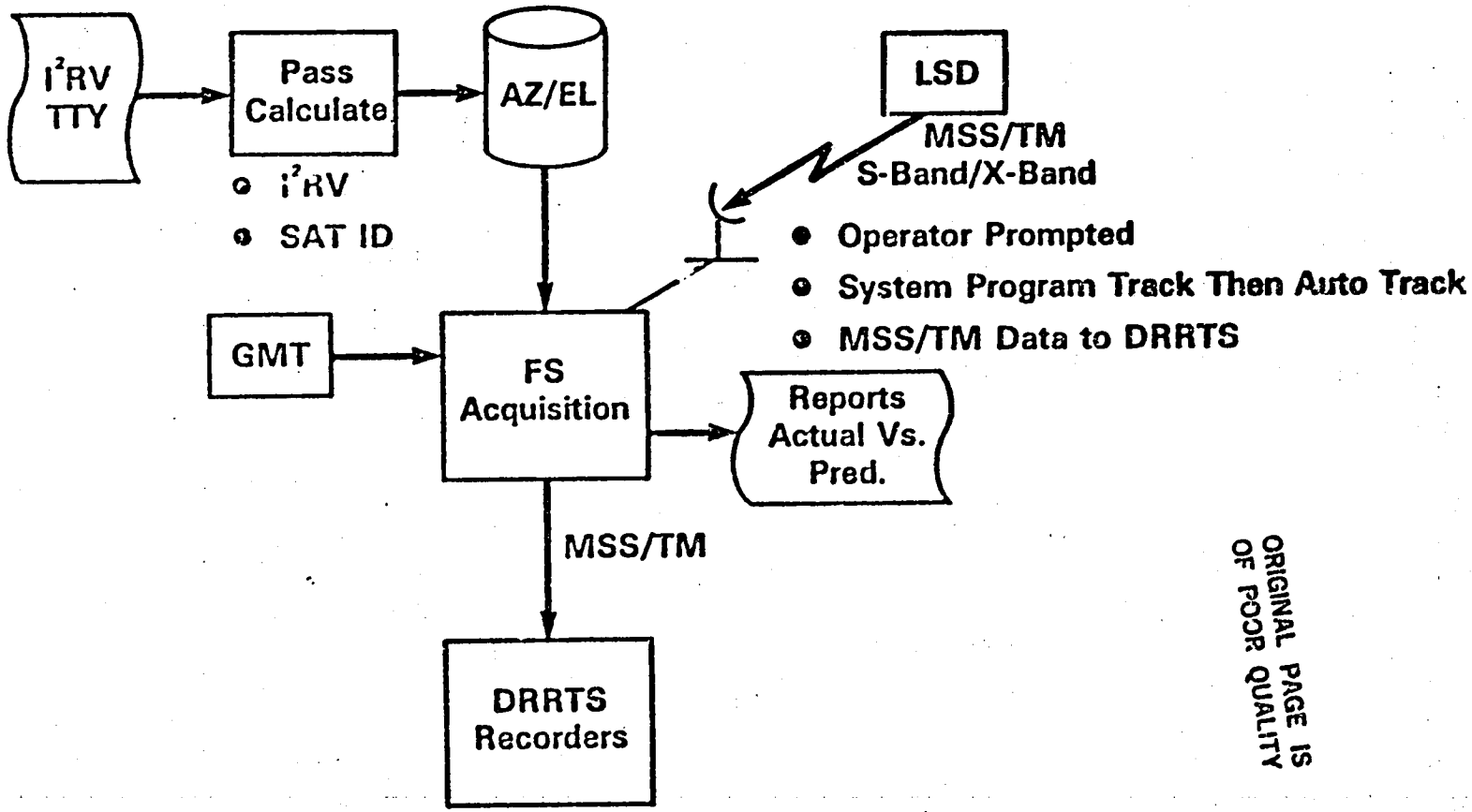
- Early Orbit and Contingency
- TGS

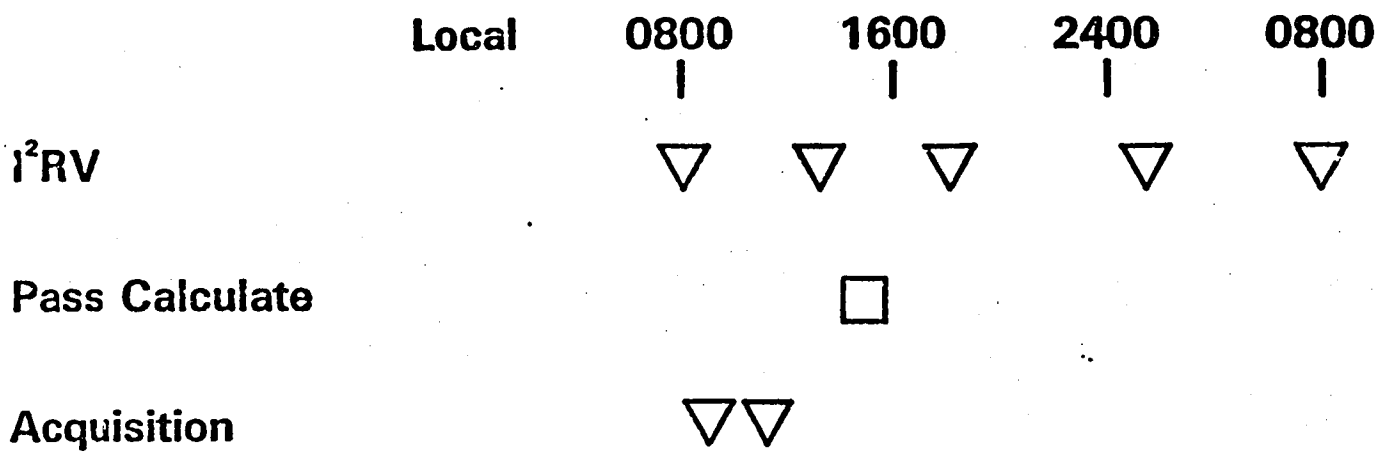
TGS Activity Flow



TGS Support Resource Requirements

- TGS System Engineer/TGS Specialist (2)
- Run in Support of MSS/TM Daytime and Occational TM Nighttime Requirements for Eastern U.S.
- Greenbelt, TGS and Recorders in DRRTS

TGS Timeline



TGS Operator Display

```
NEXT PASS:    AOS     88 14: 9: 7.154
              23.930   0.011
              LOS =  88 14:24:49.310
             169.437   0.002
              MI EL =   32.640
              SAT ID =    2
              LENGTH =     942 SECONDS


 ACQUISITION COMMENCING - AOS =  88 14: 9: 7.154
                          LOS =  88 14:24:49.310
SATELLITE ID     2
CURRENT UTCG =  88 14: 5:25.140
UNSTOW ANTENNA

AXIS MODE:  AZIMUTH =    0 ELEVATION =    0
UTCGC=088 14:05:26290 CMND=000.000/000.000 STAT=000.000/000.000 DELT=000.000 SECONDS
UTCGC=088 14:05:26290 CMND=000.000/000.000 STAT=000.000/000.000 DELT=000.000 SECONDS
UTCGC=088 14:05:26290 CMND=000.000/000.000 STAT=000.000/000.000 DELT=000.000 SECONDS
UTCGC=088 14:05:26290 CMND=023.934/000.010 STAT=026.916/001.186 DELT=000.000 SECONDS
UTCGC=088 14:05:26290 CMND=023.934/000.010 STAT=026.916/001.186 DELT=000.000 SECONDS
ANTENNA IN POSITION
UTCGC=088 14:07:27850 CMND=023.934/000.010 STAT=023.944/000.010 DELT=000.000 SECONDS
UTCGC=088 14:07:27850 CMND=023.934/000.010 STAT=023.944/000.010 DELT=000.000 SECONDS
UTCGC=088 14:07:27850 CMND=023.934/000.010 STAT=023.944/000.010 DELT=000.000 SECONDS
UTCGC=088 14:09:24340 CMND 024.683/000.879 STAT=024.796/000.999 DELT=000.000 SECONDS
UTCGC=088 14:09:45160 CMND=025.688/002.009 STAT=025.702/002.010 DELT=000.000 SECONDS
ACQUISITION COMPLETED
AOS TIME =  88 14: 9: 7.154/ 88 14:10: 0.690
DELTA =   -53 SECONDS
AOS POSITION = ( 26.216/ 26.230)/(  2.588/  2.587)
UTCGC=088 14:10:25390 CMND=028.023/004.492 STAT=027.960/004.674 DELT=000.102 SECONDS
UTCGC=088 14:10:55400 CMND=029.935/006.390 STAT=029.877/006.514 DELT=000.137 SECONDS
UTCGC=088 14:11:25390 CMND=032.091/008.398 STAT=032.019/008.492 DELT=000.101 SECONDS
UTCGC=088 14:11:55210 CMND=034.524/010.513 STAT=034.447/000.000 DELT=000.075 SECONDS
UTCGC=088 14:12:25390 CMND=037.351/012.790 STAT=037.260/012.826 DELT=000.095 SECONDS
UTCGC=088 14:12:55870 CMND=040.648/015.223 STAT=040.556/000.000 DELT=000.085 SECONDS
```

APPENDIX A

MASTER ACRONYM LIST

INTRODUCTION

The Master Acronym List is intended to be a central reference
General Electric Space Division Lanham Operations Center. I
gathered by the Data Systems Software Engineering Techn
variety of sources including: Landsat-D Flight Segment and
specifications, the Commonly Used Space Division Abbrev
Dictionary (CUSDARD) and government-issued documents.

AB	Acceptance Baseline
ACE	Attitude Control Electronics
ACK	Acknowledgement
ACS	Attitude Control System
ACT	Application Concept Test
A/D	Analog to Digital
ADCP	See ANDP
ADFS	Automated Digital Facsimile System
ADL	Applications Development Laboratory
ADP	Automatic Data Processing
ADPE	Automatic Data Processing Equipment
A&DS	Aerospace and Data Systems
ADS	Angular Displacement Sensor
AEM	Applications Exploratory Mission
AFGWC	Air Force Global Weather Central
AFOS	Automation of Field Operations and Services
AFPRO	Air Force Plant Representative Office
AG	Archive Generation
AGC	Automatic Gain Control
AGE	Aerospace Ground Equipment
AGS&PO	Aerospace Group Strategic Planning and Programs Office
Ahr	Ampere - hour
ALU	Algorithm Logic Unit
AMR	Annual Manpower Review
AN	Alteration Notice
ANCP	See ANDP
ANDP	Ancillary Data Calculation Process
ANSI	American National Standards Institute
ANT	Ascending Node Table
AO	Announcement of Opportunity
AOIPS	Atmospheric and Oceanographic Image Processing System
AOP	Advanced Onboard Processor
AOS	Acquisition of Signal
AP	Applications Processor
AP	Array Processor
APFO	Aerial Photography Field Office
APL	Applied Physics Laboratory (Johns Hopkins Univ.)
APM	Assistant Project Manager
APS	Antenna Positioning System
A/R	As Required
ASCII	American Standard Code for Information Interchange
ASPR	Aerospace Strategic Programs Representation
ASPR	Armed Services Procurement Regulations
ASR	Automatic Send/Receive
AST	Asynchronous System Trap
ASVT	Applications System Verification and Transfer Project
AT	Acceptance Test
ATL	Applications Technology Laboratory

ATM	Antenna Test Model
ATM	Apollo Telescope Mount
ATP	Acceptance Test Plan
ATS	Applications Technology Satellite
AWG	American Wire Gauge
BARDJA	Boom Antenna Retention Deployment and Jettison Assembly
BAT	Bench Acceptance Test
BB	Build Baseline
BCU	Bus Coupling Unit
BDF	Block Data Format
BER	Bit Error Rate
BESS	Biological Experiment Scientific Satellite
BFR	Browse Film Recorder
BIC	Band Interleaved by Cylinder
BIL	Band Interleaved by Line
BIP	Band Interleaved by Pixel
BOL	Beginning of Life
BOT	Beginning of Tape
B&P	Bid and Proposal
BPA	Bus Protection Assembly
bpi	Bits per Inch
BPI	Bytes per Inch
BPO	Best Possible Offer
bps	Bits per Second
BPS	Bytes per Second
BSE	Broadcast Satellite Experimental
BSQ	Band Sequential
BSR	Back Surface Radiator
BTC	Bench Test Cooler
BTCE	Bench Test and Calibration Equipment
BTE	Bench Test Equipment
B/U	Backup
B&W	Black and White
CAL	Configured Articles List
CAL	Calibration
CARETS	Central Atlantic Regional Ecological Test Site
CASH	Catalog of Available and Standard Hardware
CAT	Catalog
CCA	Cloud Cover Assessment
CCB	Configuration Control Board
CCC	Camera Controller Combiner
CCD	Charge Coupled Device
CCL	Closed Circuit Loop
CCN	Contract Change Notice
CCP	Cloud Cover Assessment Process
CCT	Computer Compatible Tape

CCT-A	CCT Containing Partially-Corrected Data
CCT-AT	CCT Containing Partially-Corrected TM Sensor Data
CCT-P	CCT Containing Fully-Corrected Data
CCT-PT	CCT Containing Fully-Corrected TM Sensor Data
C&DH	Communication and Data Handling
CDHSS	Communication and Data Handling System Simulator
CDHSS I/U	CDHSS Interface Unit
CDP	Company Development Project
CDR	Conceptual Design Review
CDR	Critical Design Review
CDRB	Conceptual Design Review Board
CDRL	Contract Data Requirements List
CEM	Controlled Environment Module
CFOV	Clear Field-of-View
CFSR	Contract Financial Status Report
CG	Center of Gravity
CI	Configuration Item
CLL	Corrected Line Length
CM	Center of Mass
C.M.	Configuration Management
CMD	Command
CMI	Configuration Management Instruction
CMM	Command Memory Management
CMMD	Corporate Manager Manpower Development
CMO	Configuration Management Office
COBOL	Common Business Oriented Language
COMP	Computer
C.P.	Center of Pressure
CP	Communication Processor
CP	Control Point
CPC	Control Point Chip
CPCI	Computer Program Configuration Item
CPD	Control Point Directory
CPDS	Computer Program Design Specification
CPG	Correction and Product Generation Software
CPL	Control Point Library
cpm	Cards Per Minute
CPM	Computer Personality Module
CPN	Control Point Neighborhood
CPPT	CZCS Preprocessor Performance Tape
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRIS	Cosmic Ray Ionization Spectrometer
CRT	Cathode Ray Tube
CSA	Cropping, Subsampling and Averaging
CSE	Contractor Supplied Equipment
CSF	Control and Simulation Facility
CSS	Coarse Sun Sensor

CTC	Cost to Complete
CU	Central Unit
CY	Calendar Year
CZCS	Coastal Zone Color Scanner
DA	Development Authorization
D/A	Digital-to-Analog
DAS	Data Base Administration Subsystem
DAS^3	De-Centralized Automated Service Support System
DBIP	Data Base Interface Process
dBi	Antenna gain in decibels referenced to an Isotropic Antenna
dBm	Power in decibels referenced to one millimeter
DBMS	Data Base Management System
DBMS-10	DEC-10 System Software for Data Base Management
DC	Direct Current
DCP	Data Collection Platform
DCS	Data Collection System
DCST	Data Collection System Tape
DDD	Days
DDG	Digital Display Generator
DDI	Digital Data Interconnect
DDL	Data Description Language
DDP	Digital Data Processor
DDP-C	Controlled Environment Module DDP
DDP-W	Wire-Wrapped DDP
DDR	Detailed Design Review
DDRB	Detailed Design Review Baseline
DEC	Digital Equipment Corporation
DEC-10	DEC-10 Computer
DEC-20	DEC-20 Computer
DECnet	Digital Equipment Corporation Communications Network
DECOM	Decommutator
DECOM	Decommutation Hardware Device
DEMUX	Demultiplexer
DFS/ADFS	Digital Facsimile System/Automated Digital Facsimile System
DI	Design Issue
DIAL	Digital Image Analysis Laboratory
DICOMED	Film Recorder
DICOMED	Film Recorder Vendor
DID	Digital Image Data
DIP	Dual Inline Package
DIPS	Digital Image Processing System
DLIO	Large Image Access Routines
D/L	Downlink
DMA	Direct Memory Access
DMF	Data Management Facility
DML	Data Management Language
DML	Data Manipulation Language

DMS	Data Management System
DMSP	Defense Meteorological Satellite Program
DO	DRRTS Operator
DOC	Data Operations Control
DOD	Department of Defense
DOD	Depth of Discharge
DOI	Department of the Interior
DOI/EDC	Department of the Interior/EROS Data Center
DOMSAT	Domestic Communications Satellite
DPM	Drafting Practices Manual
DPR	Design Problem Report
DPS	Data Processing System
DPS	DRRTS Process Software
DPSE	DRRTS Process Software Executive
DPU	Digital Processing Unit
DR11C	Programmed Input Output Interface Device for DEC Unibus
DR70	Direct Memory Access Interface Device for DEC Massbus
DR780	Direct Memory Access Interface Device for DEC VAX-11/780
DRRTS	Data Receive, Record and Transmit Subsystem
DS	Dimension (Telephone) System
DSC	Data Collection System
DSCS	Defense Satellite Communications System
DSCS	Desk Side Computer System
DSI	Deliverable Software Item
DSI	Digital Subsystem Interface Unit
DSL	Data Service Laboratory
DSM	Downlink Synchronization Module
DSSCI	Data Stripper-Serial Controller Interface
DSU	Digital Switching Unit
DTD	Digital Terrain Data
DTG	Digital Tape Generation
DTR	Daily Test Report
DTS	Digital Transmission System
DUT	Document Update Transmittal
DV	Digital Voltmeter
DX20	DEC Peripheral Interface Device
DXFP	Data Extraction and Formatting Process
EAGE	Electrical Aerospace Ground Equipment
EBCDIC	Extended Binary Coded Decimal Interchange Code
EBR	Electron Beam Recorder
EBRIC	Electronic Beam Recorder Image Correction
ECC	Error Correction Capability (HDDR)
ECEF	Earth-Centered-Earth-Fixed
ECI	Earth-Centered-Inertial
ECL	Emitter Coupled Logic
ECP	Engineering Change Proposal
EDC	EROS Data Center

EDIPS	Electronic Digital Processing System
EDIPS	EDC Digital Image Processing System
EDP	Electronic Data (Digital) Processing
EDPS	Electronic Data Processing System
EED	Electro-Explosive Device
EEO	Equal Employment Opportunity
EGRET	Explorer Gamma Ray Experiment Telescope
EGSE	Electrical Government Supplied Equipment
EI	Engineering Instruction
EIA	Electronic Industries Association
ELE	Elevation at Entry
ELS	End-of-Line Sync
ELX	Elevation at Exit
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ENA/DISA	Enable/Disable
EOB	End of Buffer
EOF	End of File
EOL	End of Life
EOM	End of Mission
EOP	Earth Observatory Program
EOP	End of Process
EORT	End-of-Roll Target
EOS	Earth Observation Systems
EOS	Earth Observations Satellite
EOS	End of Set
EO&SP	Earth Observatory and Shuttle Programs
EOT	End of Tape
EOV	End of Volume
EPA	Environmental Protection Agency
EPC	Electrical Power Conditioner
EPHEM	Ephemeris
EPI	Euler Parameter Integration
EPS	Electrostatic Plotting Software
ER	Early Release
ER	Equipment Room
ERCN	Early Release Change Notice
EREP	Earth Resources Equipment Package
EROS	Earth Resources Observation System
ERS	Earth Resources Survey
ERTS	Earth Resources Technology Satellite
ESA	European Space Agency
ESTEC	European Space Research and Technology Center
EU	Expander Unit
EVA	Extra-Vehicular Activity
EVAL	Earth Viewing Applications Laboratory
EWO	Engineering Work Order

FAIRS	Full Aperture Infrared Source
F&AO	Financial and Administrative Operations
FAS	Foreign Agricultural Service
FCS	File Control Service
FDR	Final Design Review
FFP	Federation of Functional Processors
FGS	Fine Guidance System
FHST	Fixed-Head Star Tracker
FID	Final Instrument Definition
FIFO	First-In, First-Out
FIPS	Federal Information Processing Standards
FM	Frequency Modulation
FM	Flight Model
FMEA	Failure Mode and Effects Analysis
FMS	Flight Segment Management Subsystem
FO	Flight Operations
FOC	Faint Object Camera
FORTRAN	Formula Translation
FOS	Field Operations Service
FOS	Flight Operations Subsystem
FOS	Faint Object Spectrograph
FOV	Field-of-View
FPA	Focal Plane Assembly
FPP	Floating Point Processor
FPS	Focal Plane Structure
FRD	Facilities Requirement Document
FRUSA/HASP	Flexible Roll-Up Solar Array/Hardened Solar Power System
FS	Flight Segment
FSCM	Federal Supply Code for Manufacturers
FSDF	Flight Segment Development Facility
FSEC	Fairchild Space and Electronics Company
FSK	Frequency Shift Keying
FSS	Flight Scheduling Subsystem
FSS	Flight Segment Simulator
FSS	Flight Support System
FSS	Fine Sun Sensor
FSSA	Foreign Service Salary Adjustment
FSS S/W	Flight Segment Simulator Software
FT	Fourier Transform
FTS	Federal Telephone System
FW	Fiscal Week
FY	Fiscal Year
FYI	For Your Information
G	Generation
GACA	Goodyear Aerospace Corporation, Arizona Division
GCM	Geometric Correction Matrix
GCO	Geometric Correction Operator

GCOVS	GCO Verification System
GCT	Geodetic Control Point
GCP	Ground Control Point
GDHS	Ground Data Handling System
GDT	Graphics Display Terminal
GE	General Electric
GE70	GE Interface Device for DR780
GECP	Geometric Correction Process
GEOREF	Geographic Reference
GES	Ground Electronic Specification
GETSCO	General Electric Technical Service Company
GFE	Government Furnished Equipment
GFIT	Goddard Film Inventory Tape
GFP	Government Furnished Property
GHIT	Goddard HDT Inventory Tape
GHz	Gigahertz (10^9)
GIA	Government Inspection Agency
GM	General Manager
GMF	GCO Microcode File
GMP	Geometric Correction Matrix Calculation Process
GMS	Ground Segment Management Subsystem
GMT	Greenwich Mean Time
GOES	Geostationary Operational Environmental Satellite
GOES/SDHS	Geostationary Operational Environmental Satellite/Satellite Data Handling System
GPC	General Purpose Console
GPE	Ground Processing Equipment
GPIP	General Purpose Information Processor
GPS	Global Positioning System
GPT	General Purpose Transformation
GRE	Gamma Ray Explorer
GRFP	Graphite Filled Epoxy
GS	Ground Segment
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GSSS	Ground Support System Software
GSTDN	Ground Spaceflight Tracking and Data Network
HAC	HDDR Assignment and Control
HAL	High-Order Aerospace Language
HCMM	Heat Capacity Mapping Mission
HDDR	High Density Digital Recorder
HDDT	High Density Digital Tape
HDE	HDT-R Directory Extractor
HDT	High Density Tape
HDT-A	HDT-Archive Format (Partially corrected)
HDT-AM	HDT-A for MSS Sensor Data
HDT-AMC	Copy of HDT-A for MSS Sensor Data

HDT-AT	HDT-A for TM Sensor Data
HDT-ATC	Copy of HDT-A for TM Sensor Data
HDT-I	HDT (Data) Interval
HDT-P	HDT-Product Format (Fully corrected)
HDT-PT	HDT-P for TM Sensor Data
HDT-PTC	Copy of HDT-P for TM Sensor Data
HDTR	High Density Tape Recorder
HDT-R	HDT-Raw Data
HDT-RM	HDT-R for MSS Sensor Data
HDT-RT	HDT-R for TM Sensor Data
HDT-S	HDT Recorded at White Sands
HDT-SM	HDT-S for MSS Sensor Data
HDT-ST	HDT-S for TM Sensor Data
HgCdTe	Mercury Cadmium Telluride
HIPO	Hierarchy Input Process Output
HRFR	High Resolution Film Recorder
HSCE	High Speed Control Element
HUD	Department of Housing and Urban Development
HV	Host Vehicle (Landsat-D)
H/W	Hardware
Hz	Hertz (cycles per second)
IAC	Image Analyzer Console
IAP	Integrated Analysis Plan
IAT	Image Analysis Terminal
IAT	Image Annotation Tape
IB	Integration Baseline
ICCD	Intensified Charge Coupled Device
ICD	Interface Control Document
ICS	Image Correction Support Software
ICS	Interactive Computer Simulator
ID	Identification
IDB	Identification Burst
IDBS	International Data Base Systems
IDS	Image Data System
IDT	Investigation Definition Team
IDT	Image Display Terminal
IDT	Industrial Data Terminal Corporation
I/F	Interface
IF	Intermediate Frequency
IFD	In-Flight Disconnect
IFOV	Instantaneous Field-of-View
IG	Initial Gap
IGF	Image Generation Facility
IIGS	Initial Image Generation Subsystem
IIRV	Improved Inter-Range Vectors
IIS (I^2S)	International Imaging Systems
IM	Information Management

IM	Instrument Module
IMPAC	Image Processing and Analysis Center
IMS	Information Management Subsystem
IMSC	Information Management Subsystem Computer
IMSFCC	Information Management Subsystem FFP Control Computer
IMU	Image Memory Unit
InSb	Indium Antimonide
INTRALAB	Information Transfer Laboratory
I/O	Input/Output
IPC	Initial Product Creation
IPCS	Information Production Control System
IPD	Information Processing Division
IPF	Image Processing Facility
ips	Inches per Second
IPS	Image Processing Subsystem
IPS-1	IPS String #1 Computers
IPS-2	IPS String #2 Computers
IPSC	IPS Computer
IQL	Interactive Query Language
IR	Infrared
IRB	Integrated Requirements Board
IR&D	Independent Research and Development
IRD	Interface Requirements Document
IRFPA	Infrared Focal Plane Assembly
IRG	Inter-Record Gap
IRIG	Inter-Range Instrumentation Group Time Code
IRIG-A	IRIG Time Code Series A
IRP	Infrared Photometer
IRQ	Interrupt Request
IRU	Inertial Reference Unit
IS	Input Subsystem
ISA	Instrument Standard of America
ISAM	Index Sequential Access Method
IS&CC	Information Systems and Computer Center
I&SE	Installation and Service Engineering Business Division
ISM	Interface Switching Module
ISS	Image Generation Facility Software Subset
ISU	Input Scanner Unit
IT	Integration Test
I&T	Integration and Test
ITD	Inception-to-Date
ITD	Incurred-to-Date
ITP	Integration Test Plan
IU	Interface Unit
IUE	International Ultraviolet Explorer
IUS	Interim Upper Stage

JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
K	A Thousand
K	1024 (Memory Usage Only)
Kb	Kilobit
KB	Kilobyte
Kbps	Kilobits per Second
KBPS	Kilobytes per Second
KCRT	Keyboard Cathode Ray Tube
KL10	CPU for DEC-10 Computer
km	Kilometer
KSA	Ku-band Single Access
KSC	Kennedy Space Center
KW	Kilowords
LA36	DEC Hardcopy Terminal
LACIE	Large Area Crop Inventory Equipment
LANDSAT	Land Satellite
LaRC	Langley Research Center
LAS	Landsat-D Assessment System
LAT	Latitude
LBP	Library Build Process
LBR	Laser Beam Recorder
LCP	Left-hand Circularly Polarized
LDDPM	Load DDP Module
LED	Light-Emitting Diode
LFC	Left-Fill Count
LIDU	Large Image Display Utility
LIFO	Last-In, First-Out
LLA	Adjusted Line Length
LLC	Line Length Code
LM	Line Monitor
LMM	Landsat Mission Management
LMSC	Lockheed Missile and Space Corporation
LOE	Level of Effort
LONG	Longitude
LOS	Line of Sight
LOS	Loss of Signal
LPC	Longitudinal Parity Check
LPM	Line Point Marker
LPM	Lines per Minute
LPM	Load Point Marker
LRA	Laser Retrodirector Array
LRC	Longitudinal Redundancy Check
LRD	Laser Retrodirector
LSB	Least Significant Bit

LSD	Landsat-D
LTC	Light Transfer Characteristics
LTTS	Long-Term Tape Storage Facility
LTU	Line Test Unit
LUN	Logical Unit Number
LV	Launch Vehicle
M	Mega-
M	Million
MA	Multiple Access
MACS	Modular Attitude Control System
MAG	MSS Archival Product Generation
MAP	Macro Array Processor
MASSBUS	High Speed Bus for DEC Equipment
MATSCO	Management and Technical Services Company
Mb	Megabit
MB	Megabyte
MBA	MASSBUS Adaptor
MCC	Mission Control Center
MCCA	Manual Cloud Cover Assessment Package
MCR	Monitor Console Routine
MCTF	Mission Contractor Test Facility
M&DO	Mission and Data Operations
M&DOD	Mission and Data Operations Directorate
MDM	Multiplex-Demultiplex
MDP	Master Data Processor
MEM	Module Exchange Mechanism
MERITS	Marshall Earth Resources Information Transfer System
METSAT	Meteorological Satellite
MFB	Major Frame Buffer
MFD	Master File Directory
MFS	Major Frame Synchronization
MGSE	Mechanical Government Supplied Equipment
MHS	MSS/HDDR Service
MHW	Multi-Hundred Watt
MHz	Megahertz (10^6)
MIF	Master Information File
MIP	Management Information Process
MIPS	Mega-Instructions per Second
MIS	Mission Interface Subsystem
MIT	Master Information Table
mm	Millimeter
MM	Minutes
MMF	Mission Management Facility
MMFCC	Mission Management Facility Control Computer
MMS	Mission Management Subsystem
MMS	Multi-Mission Modular Spacecraft
MMU	Memory Management Unit

NASTRAN	NASA Structural Analysis (Program)
NASTRAN	NASA Transient Analysis System
NBTR	Narrow Band Tape Recorder
NCC	National Climatic Center
NCC	Network Control Center
NCCS	Network Control Center Subsystem
NCIC	National Cartographic Information Center
ND	Networks Directorate
NDF	Neutral Density Filter
NDPF	NASA Data Processing Facility
NDS	Navigation Data Satellite
NDS	Navigational Development Satellite
NESS	National Environmental Satellite Service
NMI	NASA Management Instructions
NOAA	National Oceanic and Atmospheric Administration
NOCC	Network Operations Control Center
NOSS	National Oceanographic Satellite System
NRC	Nuclear Regulatory Commission
NRZ	Non-Return to Zero
NRZI	Non-Return to Zero Incrementing
NRZ-L	Non-Return to Zero-Level
NSCI	NASA Serial Controller for Input (now PSDI)
NSCO	NASA Serial Controller for Output (now SPDO)
NSSC-1	NASA Standard Spacecraft Computer - Model 1
NSSDC	National Space Science Data Center
NTR	New Technology Representative
NTSC	National Television System Committee
NTTF	Network Test and Training Facility
OAO	Orbital Astronomy Observatory
OAO	OAO Corporation
OAOCO	OAO Corporation
OAS	Orbit Adjust Subsystem
OBC	Onboard Computer
OBP	Onboard Processor
OCB	Operational Configuration Baseline
OCC	Operations Control Center
OCD	Operator Control and Display
OCG	Orbit Computations Group
OCR	Optical Character Reader
ODF	Orbit Determination Facility
ODP	Online Display Process
ODT	Online Debugging Tool
O&M	Operations and Maintenance
OFLS	Offline System
ONLS	Online System
OPS	Operations
O/S	Operations Supervisor

MNFS	Minor Frame Synchronization
M&O	Maintenance and Operations
MODEM	Modulator/Demodulator
MOI	Moments of Inertia
MOL	Manned Orbiting Laboratory
MOM	Mission Operations Manager
MOPS	Mega-Operations per Second
MOR	Mission Operations Room
MOU	Memorandum of Understanding
MPP	MSS Preprocessor
MPS	Mission Planning System
MPS	Modular Power Subsystem
MPT	Maximum Power Tracker
MPY	Multiply
MR	Material Requisition
MRA	Maintenance Requirements Analysis
MRAM	Maintenance Requirements Analysis Matrix
MRC	Master Reference Cube
MRS	Module Reference System
MSB	Most Significant Bit
MSC	Manned Space Center
MSCO	Mission Support Coordination Office
MSC	Matrix Switch Control
MSEC	Millisecond
MSFC	Marshall Space Flight Center
MSR	Monthly Status Review
MSS	Module Support Structure
MSS	Multi Spectral Scanner
MSW	Matrix Switch
MT	Magnetic Tape
MT	Management Tax
MTBF	Mean Time Between Failures
MTF	Modulation Transfer Function
MTL	Material
MTM	Mechanical Test Model
MTM	Modification Transmittal Memorandum
MTP	MSS Telemetry Processor
MTTR	Mean Time to Repair
MTU	Magnetic Tape Unit
MUX	Multiplexer
MW	Megawords
N_2	Purified and Filtered Gaseous Nitrogen
N/A	Not Applicable
NAK	Negative Acknowledgement
NAPPS	Nimbus/AEM Preprocessor System
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network

OS	Operating System
OSO	Orbiting Solar Observatory
OSR	Optical Solar Reflector
OSS	Office of Space Science
OSS	Operating System Software
OTA	Optical Telescope Assembly
OTDA	Office of Tracking and Data Acquisition
PA	Public Address
PAGASA	Philippines Atmospheric, Geological and Astronomical Science Administration
PAL	Potentially Applied Labor
PALM	Product Assurance List of Materials
PAM	Pulse Amplitude Modulation
PAPE	Product Assurance Project Engineering
PAR	Program Appraisal and Review System
PARAM	Parameter
PATH	Orbital path
P/B	Playback
PBX	Private Branch Exchange
PC	Production Control
PC	Program Counter
PC	Printed Circuit
PCB	Printed Circuit Board
PCD	Payload Correction Data
PCD	Photon Counting Detector
PCM	Pulse Code Modulated
PCP	Product Control Procure
PCP	Program Control Procedure
PCS	Payload Correction Subsystem
PCU	Power Control Unit
PD	Payload Disconnect
PD	Program Directive
PD	Programmable Decommutator
PDF	Programmable Data Formatter
PDL	Program Design Language
PDP	Programmable Digital Processor
PDP	Peripheral Data Product
PDR	Preliminary Design Review
PDR	Problem/Defect Report
PDSS	Precision Digital Sun Sensor
PDU	Power Distribution Unit
PE	Performance Evaluation
PE	Phase Encoded
P&E	Plant and Equipment
PES	Performance Evaluation Subsystem
PET	Predicted Ephemeris Tape
P/F	Protoflight

PFD	Pre-Flight Disconnect
PFI	Program Funding Instructions
PGCOP	Product Generation CCT Output Process
PGHIP	Product Generation HDT Input Process
PGHSM	Product Generation HDT-P Simulator
PGLOP	Product Generation LBR Output Process
PGLSM	Product Generation LBR Simulator
PGM	Program Manager
PGMON	Product Generation Pipeline Monitor Process
PGP	Product Generation Process
PGS	Product Generation Subsystem
P/I	Policy/Instruction
PI	Principal Investigator
PIF	Pseudo Image File
PIGP	Pseudo Image Generation Program
PIL	Pixel Interleaved by Line
PIO	Programmed Input Output
PIP	Peripheral Interchange Program
PIR	Program Information Request/Release
PIXEL	Picture Element
PKG	Package Design Specification
P/L	Payload
PLACE	Post Landsat-D Advanced Concepts Evaluation
PM	Preventive Maintenance
PM	Propulsion Module
PMB	Program Management Budget
PMD	Post-Mortem Dump
PM/FL	Performance Monitor/Fault Location
PMM	Program Maintenance Manual
PMP	Premodulation Processor
PMT	Photomultiplier Tube
PN	Pseudo Noise
PO	Purchase Order
POCC	Payload Operations Control Center
POD	Project Operations Directors
POP	Project Operating Plan
PORTS	Preliminary Operations Requirements and Testing Support
POWO	Purchase Order Work Order
PPL	Photo Processing Lab
PPL	Preferred Parts List
PPO	Program Participation/Opportunities System
PPS	Photographic Processing Subsystem
PRMIS	Printing Resource Management Information
PRN	Pseudo Random Noise
PRO	Payload Receiving Operations
PROM	Programmable Read-Only Memory
PRP	Performance Recognition Program
PRU	Power Regulator Unit

PS	Polar Stereographic
PSDO	Parallel-to-Serial Data Output Device
PSF	Photo/Shipping Support Facility
PSK	Phase Shift Keying
PSM	Programmable Sync Module
PSR	Project Status Review
PSU	Power Supply Unit
PSU	Power Switching Unit
PVS	Pressure Vessel Spacecraft
PWB	Printed Wiring Board
PWM	Pulse Width Modulated
Q&A	Qualification and Acceptance
QA	Quality Assurance
QAP	Quality Assessment Process
QAP	Quality Assurance Procedure
QAP	Qualification and Acceptance Program
QC	Quality Code
QFP	Quality Assurance Film Generation Process
QIO	Queued Request for Input/Output
QIO	Queue Input/Output Process
QLM	Quick-Look Monitor Unit
QLP	Quick-Look Processor
QLPS	Quick-Look Processing System
QPSK	Quadrative Phase Shift Keyed
QRWO	Quick-Reaction Work Order
QSL	Quarter Scan Line
RAM	Random Access Memory
RBV	Return Beam Vidicon
RC	Radiometric Correction
RCFP	Radiometric Correction Function Calculation Process
RCHP	Right-Hand Circularly Polarized
RCP	Registration Control Point
RCP	Right-Hand Circularly Polarized
RCV	Receive
R&D	Research and Development
RDCP	Radiometric Corrected Process
RDCP	Radiometric Function Calculation Process
RDT	Raw Data Tape
REC	Record
REM	Rocket Engine Module
RF	Radio Frequency
RFC	Right-Fill Count
RFH	Request for Hire
RFOV	Resolution Field-of-View
RFP	Request for Proposal
RH780	Massbus Adaptor for DEC VAX-11/780

RID	Review Item Discrepancy
RIU	Remote Interface Unit
RMS	Remote Manipulator System
RMS	Root Mean Square
RMS	Record Management Services
ROM	Read-Only Memory
ROW	Geographic Frame Reference
RP06	DEC 176 MB Disk or Removable Disk Storage Unit
RP07	DEC 287 MB Disk
R/PA	Receiver/Processor Assembly (GPS)
R&PA	Reliability and Product Assurance
RPM	Revolutions Per Minute
RPP	RBV Preprocessor
R&QA	Reliability and Quality Assurance
RSE	Receiving Site Equipment
RSE	Remote Site Equipment
RSS	Request Support Subsystem
RSX-11M	Multi-Tasking Operating System Software
R/T	Real-Time
RTG	Radioisotope Thermoelectric Generator
RTTS	Real-Time Test System
RX	Receive
SA	Single Access
SA	Solar Array
SAD	Solar Array Drive
SADAPTA	Solar Array Drive and Power Transfer Assembly
SAIL	Space Applications and Information Library
SARJA	Solar Array Retention, Deployment and Jettison Assembly
SB	Stage Baseline
SBC	Single Board Computer
SBI	Synchronous Backplane Interconnect
SBS	Space Background Simulator
SBU	Strategic Business Unit
S/C	Spacecraft
SC	Signal Conditioning
SCA	Signal Conditioning Assembly
SCAMA	Switching, Conferencing and Monitoring Arrangement
SCCB	Software Change Control Board
SCHS	Spacecraft Hardware Simulator (MSS Simulator)
SCI	Serial Control Interface
SCII	Serial Control Interface for Input (now SPDI)
SCIO	Serial Control Interface for Output (now PSDO)
SCL	Subcontract Labor
SCN	Specification Change Notice
SCP	Sun Calibration Process
SCR	Scaler Control Register
SCR	Software Change Request

SC&SU	Signal Conditioning and Switching Unit (SU)
SCT	System Control Terminal
SD	Space Division
SDF	Software Development Facility
SDHS	Satellite Data Handling System
SDISS	Satellite Data Ingest and Storage Subsystem
SDSB	Satellite Data Services Branch
SEAM	Software Engineering and Management Program
Sec	Seconds of Arc
SECO	Secondary Electron Conduction Orthicon
SEID	Systems Engineering and Integration Division
SEOPS	Standard Earth Observation Package Satellite
SEOS	Synchronous Earth Observation Satellite
SHP	Shipping
SI	Science Instruments
SI	Standing Instructions
SIAT	Special Image Annotation Tape
SICM	Science Instrument Central Module
SIDU	Small Image Display Utility
SIF	Simulation Image File
SIM	Simulator
SIP	System Image Preservation
SIRD	Support Instrumentation Requirement Document
SIU	Sectorizer Ingest Unit
SLAT	Spacecraft Location and Attitude Tape
SLC	Scan Line Corrector
SLP	Source Language Input Program
SLS	Scan Line Sync
SLS	Start-of-Line Sync
SMA	S-Band Multiple Access
SMA	Scan Mirror Assembly
SMM	Solar Maximum Mission
SM&O	Support Maintenance and Operations
SMR	Software Modification Record
SMSA	Standard Metropolitan Statistical Area
S/N	Signal-to-Noise Ratio
SNR	Signal-to-Noise Ratio
SOM	Space Oblique Mercator
SOP	Standard Operating Procedure
SOW	Statement of Work
SP	Stack Pointer
SPC	Small Peripheral Controller
SPD	DEC Software Product Description
SPDI	Serial-to-Parallel Data Input Device
SPM	Sub-Project Manager
SPP	Special Purpose Processor
SPR	Software Problem Report
SPRD	Site Preparation Requirements Document

SPS	Segment Processing Subsystem
SPU	Scene Processing Unit
SQA	Software Quality Assurance
SRCDR	Software Requirements and Conceptual Design Review
SRCDS	Software Requirements and Conceptual Design Specification
SRR	System Requirements Review
SRS	Software Requirements Specification
SRS	System Requirement Specification
SRT	Supporting Research and Technology
SS	Seconds
S/S	Subsystem
SSA	S-Band Single Access
SSC	Science Support Center
SSDA	Sequential Similarity Detection Algorithm
SSM	Support Systems Module
SSO	Space System Operations
SST	Synchronous System Trap
ST	Space Telescope
ST	Stored
STA	Station
STACC	Standard Telemetry and Command Components
STACC-CU	STACC Central Unit
STACC-STINT	STACC Interface Unit
STC	System Test Console
STD	System Task Directory
STD	Standard
STDN	Spaceflight Tracking and Data Network
STEP	Space Technology Engineering Program
STINT	Standard Interface for Onboard Computer
STINT	STACC Interface Unit
STOCC	Space Telescope Operations Control Center
STOL	System Test and Operations Language
STP	System Test Plan
STR	Standard S/C Telemetry Recorder
STR	Standard Tape Recorder
STR	System Test Review
STS	Space Transportation System
STS	Shuttle Transportation System
STSOC	Space Telescope Scientific Operations Center
SU	Switching Unit
SVS	Space Vehicle Specification
S/W	Software
SWG	Science Working Group
SYCI	System Corrected Images
TA	Transistor Adaptor
TAC	Telemetry and Command
TAG	TM Archival Product Generation

TAM	Three Axis Magnetometer
TAS	Tape Archives Subsystem
TAS	Tape Archival Storage Area
TBA	To Be Announced
TBD	To Be Determined
TBD	To Be Defined
TBR	To Be Resolved
TBS	To Be Specified
TBS	To Be Supplied
TBV	To Be Verified
T/C	Time Code
TCC	Time Code Controller
TCG	Time Code Generator
TCI/OSC	Time Code In/Oscillator
TCOM	Army Test and Evaluation Command
TCO/PAN	Time Code Out/Panel
TCS	Thermal Control System
TCU	Time Code Unit
T&D	Test and Diagnostic
TD	Test Directives
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
T&E	Test and Evaluation
TEP	Telemetry Extraction Process
TERSSE	Total Earth Resources System for the Shuttle Era
TGS	Transportable Ground Station
TIROS-N	Television Infrared Observing System
TIS	Technical Information Series
TKTN	Task Termination Notification
T&L	Travel and Hiring
TLM	Telemetry
TM	Thematic Mapper
TM	Telemetry
TMV	Telemetry Volts
TOD	True-of-Date
TOSS	TERSSE Operational System Study
TP	Telemetry Processor
TPG	Test Pattern Generator
TPL	Test Plan
TR	Tape Recorder
TRB	Test Review Board
TRF	Tracking and Receiving Facility
TRK	Track (HDDR)
TRKG	Tracking
TRP	Technical Recognition Program
TRW	TRW Defense and Space Systems Group
T/S	Thermal/Structural
TSIM	Test and Simulation Subsystem

TSSC	Technical Support Services Company
TSSF	Tape Staging and Storage Facility
TTA	Triangular Transition Adaptor
TT&C	Telemetry Tracking and Command
TTL	Transistor Logic Device
TTY	Teletype
TU45	1600 bpi Magnetic Tape Unit
TU72	6250 bpi Magnetic Tape Unit
TU78	6250 bpi Magnetic Tape Unit
TUG	Final Upper Stage
TV	Television
TWT	Traveling Wave Tube
TWTA	Traveling Wave Tube Amplifier
TX	Transmit
UARS	Upper Atmosphere Research Satellite
UBA	Unibus Adaptor
UBC	Unit Block Controller
UDDPM	Unload DDP Module
UDF	Unit Development Folder
UFD	User File Directory
UHF	Ultra High Frequency
UIC	User Idenfification Code
U/L	Uplink
UNIBUS	Universal Bus
UPAL	Unapplied Potential Applied Labor
UQPSK	Unbalanced Quadrature
USART	Universal Synchronous Asynchrorous Receiver Transmitter
USB	Upper Side-Band
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
VA	Value Analysis
VAC	Volts, Alternating Current
VAP	Verification Acceptance Program
VAX-11/780	Virtual Address Extension DEC Model Computer 11/780
VCO	Voltage-Controlled Oscillator
VCRI	Verification Cross-Reference Index
VDC	Volts, Direct Current
VDD	Version Description Document
VE	Value Engineering
VECP	Value Engineering Change Proposal
VF	Valley Forge
VFSC	Valley Forge Space Center
VHF	Very High Frequency
VHRR	Very High Resolution Radiometer
VIP	Virtually Interfaced Peripheral

VM	Value Management
VMS	Virtual Memory Operating System
VPASS	Video Processor and Sync Separator
VPIR	Video Processor/Image Recorder
V/T	Vacuum Thermal
VT	Verification Test
VT78	Intelligent CRT Terminal
VT100	Non-Intelligent CRT Terminal
VTR	Video Tape Recorder
WACA	Weeks After Contract Acceptance
W/B	Wideband
WBM	Wideband Module
WBS	Work Breakdown Structure
WBSS	Wideband Subsystem
WBVT	Wide Band Video Tape
WBVTR	Wide Band Video Tape Recorder
WCS	Writeable Control Store
WFC	Wide-Field Camera
WLM	Work Order and Label Manager
WPC	Word Processor Center
WPM	Work Package Manager
WRS	World Reference System
WS	White Sands
WSMR	White Sands Missile Range
WTR	Western Test Range
XMIT	Transmit
XMTR	Transmitter
Z	Zulu Time (GMT)
ZWC	Zero Word Count
μ	Micro-
μm	Micrometer (-10^{-6} Meter)
μP	Microprocessor
μS	Microsecond

ACRONYMS AND ABBREVIATIONS

AAT	Archival Ancillary (Data) Tape
ADT	Ancillary Data Tape
ACCA	Automatic Cloud Cover Assessment
ACS	Attitude Control System
ADS	Angular Displacement Sensor or Angle Detector Sensor
AG	Archive Generation
AGE	Aerospace Ground Equipment
AMS	Attitude Measurement System
AOIPS	Atmospheric & Oceanographic Image Processing System
AOP	Advanced On-Board Processor
ASCII	American Standardized Code-II
AZIM	Azimuth
BIC	Band Interleaved by Cylinder
BIL	Band Interleaved by Pixel
BIW	Band Interleaved by Word
BSQ	Band Sequential
CCA	Cloud Cover Assessment
CCL	Closed Circuit Loop
CCM	Color Composite Master
CCT	Computer Compatible Tape
CCT-A	CCT containing data which has been partially processed, i.e., radiometrically corrected but not geometrically corrected
CCT-AM	CCT-A containing partially processed data from the MSS sensor
CCT-AT	CCT-A containing partially processed data from the TM sensor
CCT-P	CCT containing data which has been fully processed, i.e., both radiometrically and geometrically corrected
CCT-PM	CCT-P containing fully processed data form the MSS sensor
CCT-PT	CCT-P containing fully processed data from the TM sensor
CDD	Cartridge Removable Diablo Disk Drive
CDHS	Command and Data Handling System
CDHSS	Command and Data Handling System Simulator
CLD	Cloud
CMD	Commands
CNTR	Center
CP	Control Point
CPC	Control Point Chip
CPD	Control Point Directory
CPD-U	Control Point Directory (Candidate for permanent file)
CPL	Control Point Library
CPL-U	Control Point Library (Candidate for permanent file)
CPN	Control Point Neighborhood
CPN-G	Control Point Neighborhood for Geodetic Corrections
CPN-L	control Point Neighborhood for Library Maintenance
CPN-M	Control Point Neighborhood for MSS
CPN-T	Control Point Neighborhood for TM
CPR	Cloud Physics Radiometer
CPU	Central Processing Unit
CR	Card Reader
CRT	Cathode Ray Tube (display terminal)
CSF	Control and Simulation Facility
DAS	Data Base Administration Subsystem
DB	Data Base
DBMS	Data Base Management System
DCS	Data Collection System
DDP	Digital Data Processor
DDR	Detailed Design Review
DEC	Digital Equipment Corporation
DFD	Data Flow Diagram
DFP	Data Formatter Processor
DL	Downlink
DMS	Data Management System
DOMSAT	Domestic Communication Satellite
DPU	Digital Processing Unit
DRIRU	Dry Rotor Inertial Reference Unit
DRTS	Data Reciave, Record, Transmit Subsystem

DSC	Data Collection System
DSN	Downlink Synchronization System
EBR	Electron Beam Recorder
ECC	Error Correction Code
ECI	Earth Centered Inertial (Coordinate System)
EDC	EROS Data Center
ECCMOS	Error-Correcting CMOS
EF	Earth Fixed (Coordinate System)
EROS	Earth Resources Observation Satellite or System
FDD.	Fixed (Cartridge) Diablo Disk (Drive)
FFP	Federation of Functional Processor
FMS	Flight (Segment) Management Subsystem
FOS	Flight Operations Subsystem
FPG	Final Product Generation
FRD	Facility Requirements Document
FRS	Film Recorder System
FS	Flight Segment
FSS	Flight Scheduling Subsystem
GCD	Geodetic Correction Data or Geometric Correction Data
GDCG	Geodetic Correction Data Generation
GCM	Geometric Correction Matrices
GCO	Geometric Correction Operator
GCP	Geodetic Control Point or Ground Control Point
GECP	Geometric Correction Process
GFIT	Goddard Film Inventory Tape
GHIT	Goddard HDT Inventroy Tape
GI	General Instruction
GMS	Ground (Segment) Management Subsystem
GMT	Greenwich Mean Time
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
GSSS	Ground Support System Software
GSTDN	Ground Spacecraft Tracking and Data Network
G/C	Geometric Correction
HAAT	Header, Ancillary, Annotation, Trailer
HAAT-L	HAAT for Library Maintenance

HAT	Header, Annotation, Trailer
HD	HDT Duplication
HDDR	High Density Digital (Tape) Recorder
HDT	High Density Tape
HDT-A	HDT containing data which has been partially processed, i.e. radiometrically corrected but not geometrically corrected
HDT-AM	HDT-A containing data from the MSS sensor
HDT-AT	HDT-A containing data from the TM sensor
HDT-P	Radiometrically and Geometrically Corrected High Density Tape
HDT-PT	HDT-P containing data from the TM sensor
HDT-R	HDT containing raw data as recorded in EDITS
HDT-RM	HDT-R containing data from the MSS sensor
HDT-RT	HDT-R containing data from the TM sensor
HDT-S	HDT containing data recorded at White Sands
HDT-SM	HDT-S containing data from the MSS sensor
HDT-ST	HDT-S containing data from the TM sensor
HRFR	High Resolution Film Recorder
HSI	High Speed Interface
I/O	Input/Output
I&T	Intergration and Test
ICD	Interface Control Document
ID	Identification
IDA	Image Data Acquisition
IDT	Image Data Transmission
IGF	Image Generation Facility
IPC	Initial Product Creation
IPD	Image Processing Division
IPS	Information Processing Subsystem
IQL	Interactive Query Language
IR	Infrared
IRIG-A	Inter Range Instrumentation Group Format A Timecode
KCRT	Keyboard Cathode Ray Tube (display tube)
KS	Key Station
LAS	Landsat Assessment System
LBP	Library Build Process
LBR	Laser Beam Recorder

LM	Library Maintenance
LS-D	Landsat D
LS-3	Landsat 3
LTTS	Long-term Tape Storage
MBA	Massbus Adapter
Mbps	Megabits per second
MCCA	Manual Cloud Cover Assessment
MJF	Major Frame
MIPS	MSS Image Processing Subsystem
MMF	Mission Management Facility
MMFSC	Minor Frame Synch Loss
MOU	Memoranda of Understanding
MPP	MSS Pre-processor
MS	Mirror Sweep
MSB	Most Significant Bit
MSCD-M	MSS Mirror Scan Correction Data
MSCD-T	TM Mirror Scan Correction Data
MSS	Multispectral Scanner
MSS-A	MSS Archival Data
MTU	Magnetic Tape Unit
MUX	Multiplexer
NASCOM	NASA Communication System
NCC	Network Control Center
NMI	NASA Management Instruction
NOAA	National Oceanic and Atmospheric Administration
NSCI	Renamed SPDI
NSCO	Renamed PSDO
NSSC	NASA Standard Spacecraft Computer
NTTF	NASA Tracking and Telemetry Facility
OBC	On-Board Computer
OBP	On-Board Processor
OCC	Operations Control Center
OCG	Orbit Computations Group

OCR	Optical Character Recognition
PA	Public Address
PBX	Private Branch Exchange
PCD	Payload Correction Data
PCD-M	MSS Payload Correction Data
PCD-T	TM Payload Correction Data
PCE	Pipeline Control Executive
PCS	Payload Correction Subsystem
PES	Performance Evaluation Subsystem
PGS	Product Generation Subsystem
PO	Project Office
PPL	Photographic Processing Laboratory
PS	Polar Stereographic
PSDO	Parallel to Serial Data Output device
QA	Quality Assessment
QAF	Quality Assessment Film
QC	Quality Control
QIO	Queued I/O (Input/Output)
QLD	Quick Look Display
QLM	Quick Look Monitor
RAA	Reformatting Ancillary Annotation
RBV	Return Beam Vidicon
RCP	Registration Control Point or Relative Control Point
R/P A	Receiver/Processor Assembly (GPS Data Processor)
R/C	Radiometric Correction
RLUT	Radiometric Lookup Table
RSS	Request Support Subsystem
SBI	Synchronous Back Plane Interconnect
SCISU	Signal Conditioning and Switching Unit
SCNM	Switching, Conferencing and Monitoring Arrangement
SCO	Systematic Correction Data
SCII	IDT Serial Controller Interface-Input
SCIO	IDT Serial Controller Interface-Output
SCM	Systematic Correction Matrix
S/C	Spacecraft
S/W	Software

SDF	Software Development Facility
SEAM	Software Engineering and Management
SHP	Shipping Facility
SLC	Scan Line Corrector
SLER	Synch Loss Error Rate
SMA	Scan Mirror Assembly
SMM	Solar Maximum Mission
SOM	Space Oblique Mercator
SPDI	Serial to Parallel Data Input device
SRR	System Requirements Review
SSO	Space Systems Operation
SSRR	Systems Software Requirements Review
STDN	Spaceflight and Tracking Data Network
STOL	System Test & Operation Language
STR	System Test & Review
TAC	TM Adaptive Capability
TAS	Tape Archive Storage
TBD	To Be Determined
TBS	To Be Supplied
TCG	Time-Code Generator
TDRS	Tracking & Data Relay Satellite.
TDRSS	Tracking & Data Relay Satellite System
TGS	Transportable Ground Station
TIPS	TM Image Processing Subsystem
TLM	Telemetry
TM	Thematic Mapper
TSIM	Test and Simulation Subsystem
TTY	Teletype operator console
UBA	Unibus Adapter
UL	Up Link
UTM	Universal Transverse Mercator
VAX	Virtual Address Extension (computer)
VICAR	Video Image Communication and Retrival
VMS	Virtual Memory (Operating) System
VP	Line Printer (VERSATEC)

WBVT	Wide Band Video Tape
WRS	World Reference System
WTR	Western Test Range
ZTS	Zone Transfer Scoop

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